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THE CREEK BOOK

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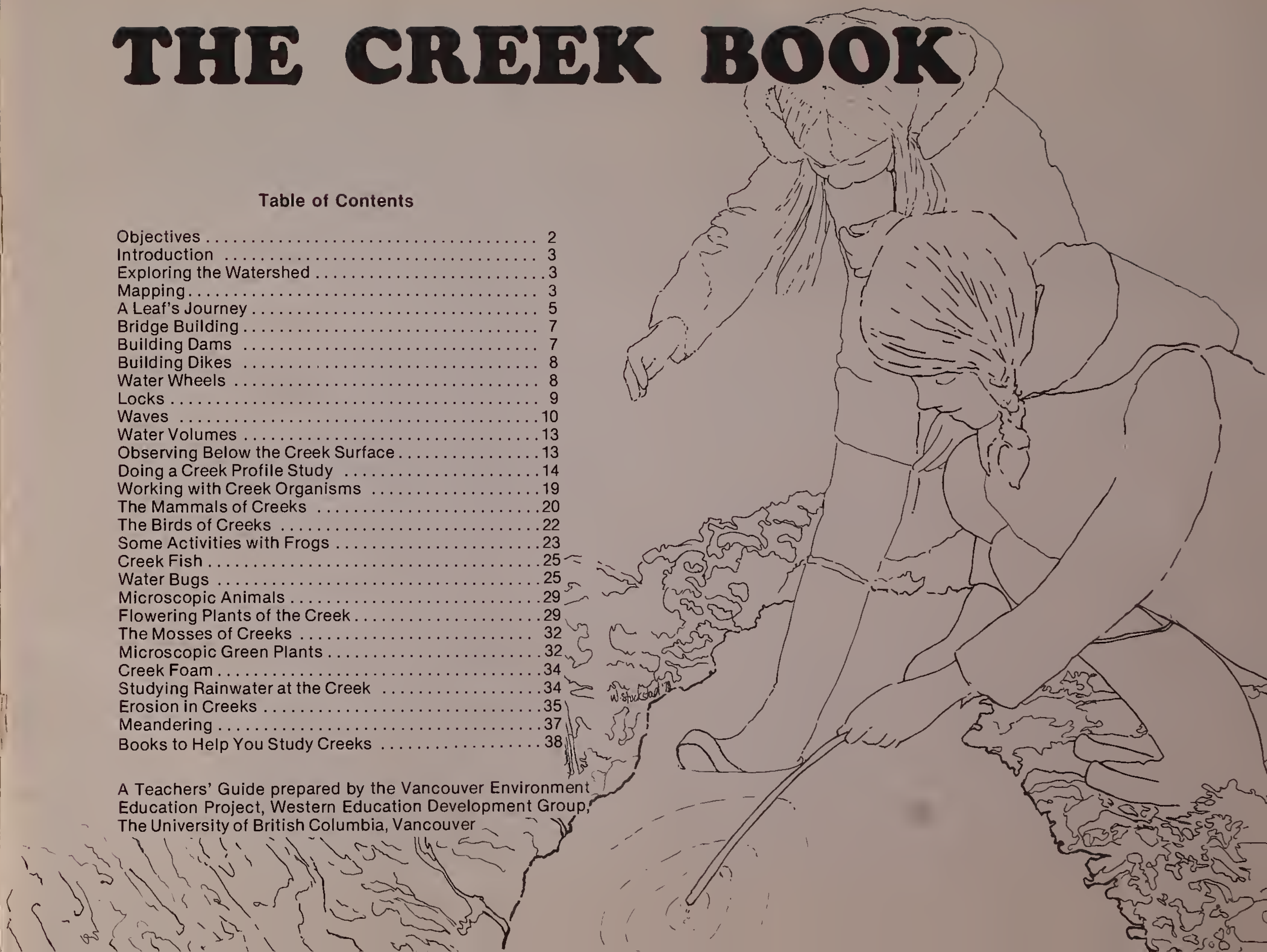
THE CREEK BOOK



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A Teachers' Guide prepared by the Vancouver Environment Education Project, Western Education Development Group, The University of British Columbia, Vancouver

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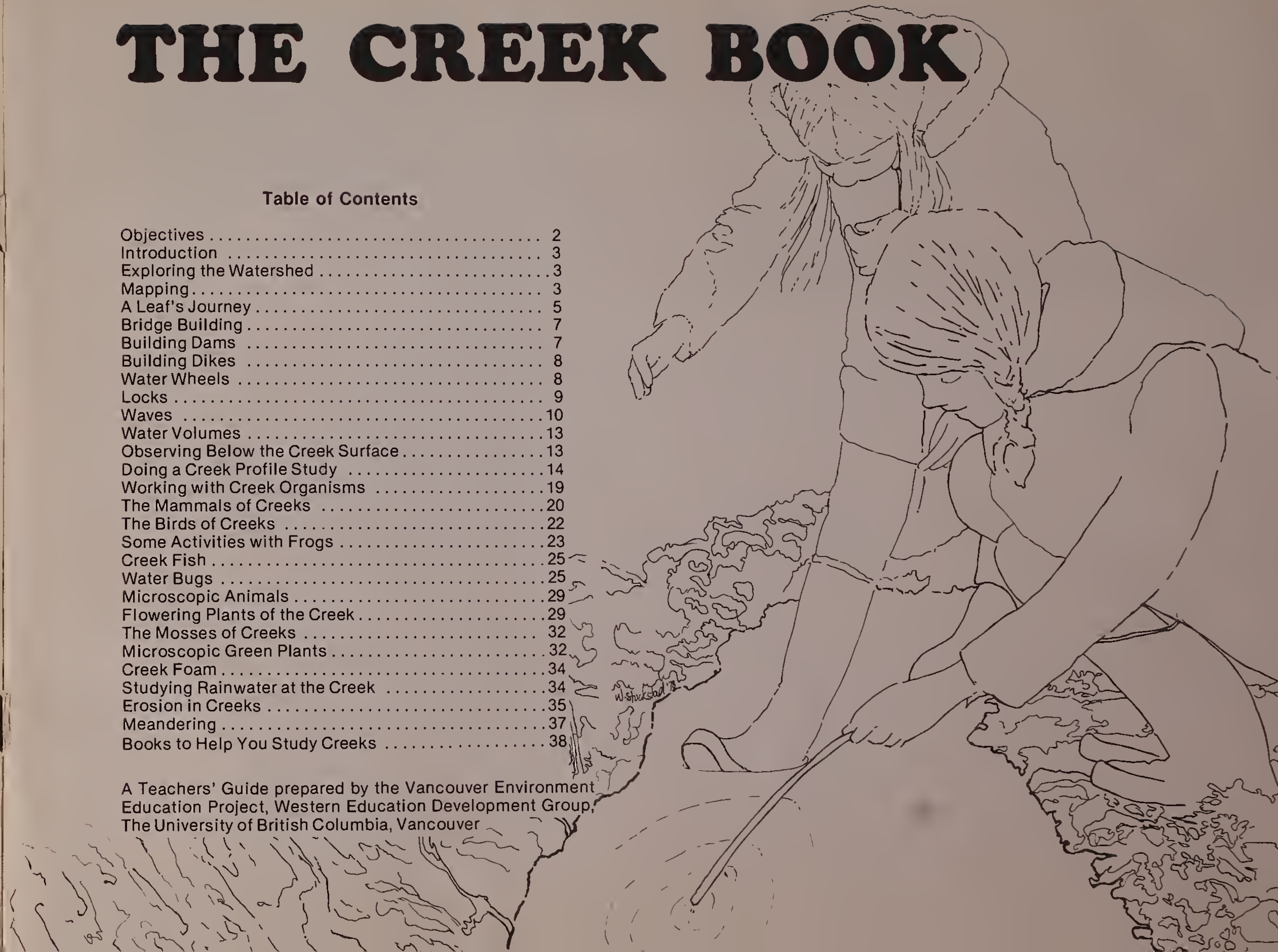

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Objectives

In examining a unit such as this unit on creeks, teachers often find a list of objectives handy for providing a summary of what children might be expected to do by its conclusion. When this unit was planned, tried, revised, rewritten, tried again, revised and rewritten, many objectives were reached and retained, others were discarded. At this point in its evolution, children who have completed this unit should be able to:

1. Explore a watershed with you.
2. Map a creek showing direction of flow and major features.
3. Take you on a leaf's journey, explaining changes in creek flow along the route.
4. Show you how to build a working bridge, a dam, a lock, a dike or a waterwheel.
5. Show you how to make waves which are long or in a circle; waves which move inside or across waves; and waves which can make a picture.
6. Carry out a creek profile study.
7. Show you how to catch creek insects, study them, identify them and put them back again.
8. Show you how to catch a creek fish or frog, study it, identify it and put it back again.
9. Show you how to collect creek plants such as algae, mosses and flowering plants, study them, identify them and return them to the creek.
10. Tell you how the water and sediments get into and out of the creek.
11. Show you how the creek can erode an island by cutting through the material it's made of and carrying it away.
12. Tell you why kids love creeks

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Introduction

Children love to explore creeks and feel the water rushing past their boots. There seems to be a natural attraction, especially in activities such as bridging, damming, and diverting the flow. A sunny afternoon spent wading up a creek, even if it has no academic result, provides an enjoyable and memorable experience.

This unit is designed to tie a learning situation in with these explorations without diminishing the excitement.

The activities suggested here require a minimum of equipment and time, and can easily be fitted into a previously scheduled program.

Exploring the Watershed

Before introducing your class to a creek be sure every member of the class has a pair of gum boots. Then go exploring. The path with the most to see and the least resistance will probably be the creek bed itself.

It would certainly be a waste of a rare moment if the first trip to a creek was not a genuine exploration. Who knows what lies around the next bend — still waters or rapids, sleeping frogs or wild game. Children's imaginations are extremely susceptible to the magic of knowing they're on the brink of a real discovery.

As an incentive to individual exploration, the only task assigned should be: finding where the creek comes from and where it goes to. Any more demands could detract from the atmosphere of adventure.

In some places, the creek will be wide and easily travelled. In others it will be narrow and nearly impossible to follow as it disappears under tree roots and undergrowth. Here the challenge will be picked up quickly by the children. Finding a fork will prove to be an exciting event too. You should find many as you approach the source. Several forks usually drain the watershed.

Many other aspects of the creek will be brought to light on this trip as unusual phenomena are discovered. Creek foam, water plants and animals, rapids, small waterfalls, and mucky sections of the creek bottom seem to catch children's attention easily.

In all of these activities, but especially this one, the teacher should attempt to follow or act as a consultant rather than lead. It is too easy to lose the charm of exploration in a guided tour. Try to avoid saying "Look at this", and "What is that?". Let the children ask these questions when they find something that truly interests them.

Mapping

Now that the students have become acquainted with the creek, a comfortable follow-up would be to map the route it

FOR YOUR INFORMATION

Should you walk in the creek while exploring?

This question is a difficult one. Generally, however, the answer depends on the sturdiness of the creek bank. The banks of creeks flowing through meadow and grass lands are generally sturdy enough to support classes walking along the edge and examining the creek. In these areas classes should stay on the bank as much as possible to avoid disturbing the ecology of the creek bottom. In forests, however, great damage can be done if classes walk along the delicate banks of creeks. The banks tend to collapse sending large quantities of soil and other debris into the creek. In forest creeks it is preferable to have pupils walk in the creeks during exploration. Research has shown that most animals which are dislodged into the current soon reattach to the bottom.

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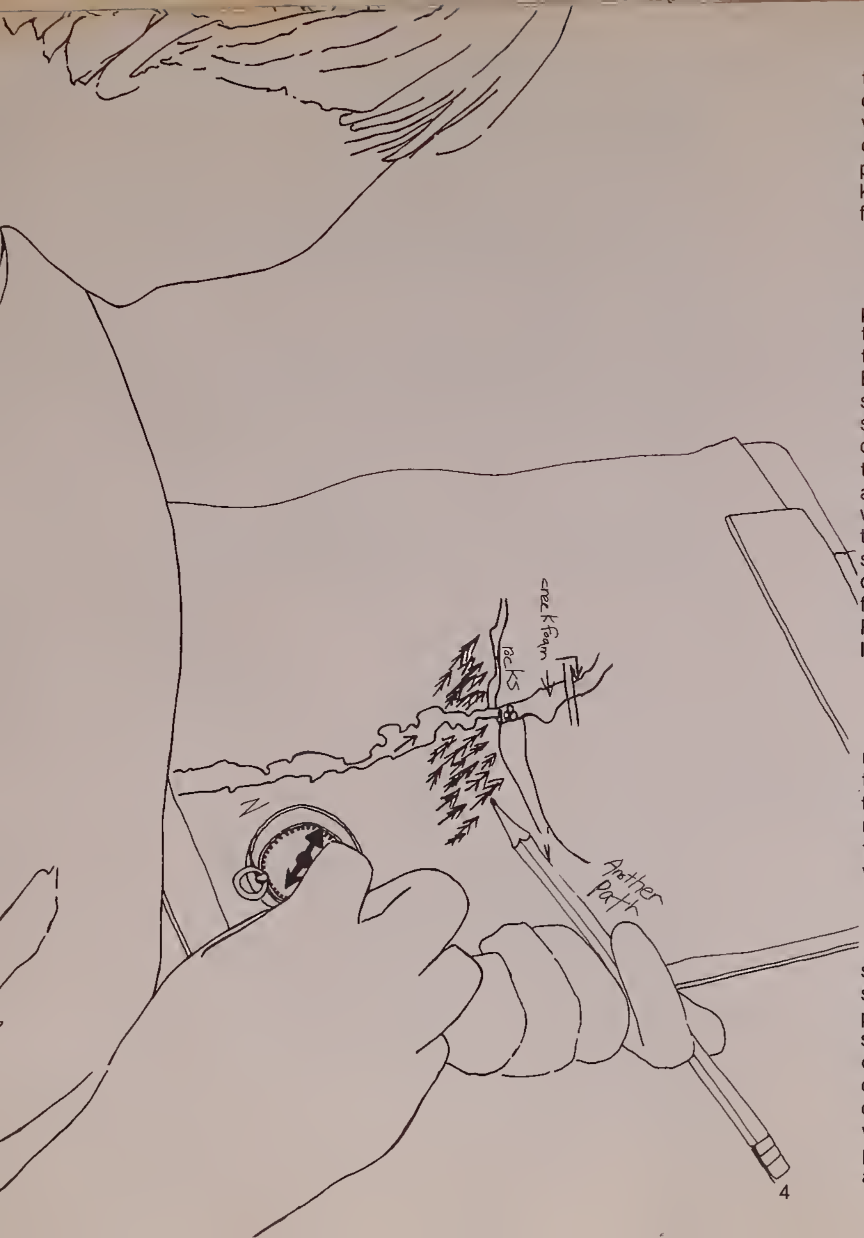


takes. The result of a class effort can be a large and fairly accurate map which will be of great value during future investigations of the creek. We suggest a large mural on the classroom wall as an end product. At the creek, graph paper, pencils with attached erasers, clipboards, compasses and a knotted or tagged string measurer are necessary equipment for this activity.

Ask the children to choose partners and assign to each pair a pre-measured, numbered section of the creek. Adjust the scale so that one square of the graph paper is equivalent to one unit of measure, e.g. 1 m^2 or one 10 m^2 block. Everyone must use the same scale in order to allow each section to be fitted together for an overall picture. Each person should note the compass direction followed by his creek section. This can be done by laying the compass on the map so that it is aligned with north and marking a north arrow on the map. Also mark an arrow in the direction in which the creek flows and map around this arrow. Every time the direction of the creek changes, a new compass reading should be taken and another arrow drawn. Symbols can be decided upon for landmarks such as rapids, waterfalls and fallen logs. One for creek foam should also be included. Pupils often prefer, however, to draw in the landmarks and label them.

Start at one end of the section and take width measurements every metre up the creek or perhaps every time the creek changes. The string measurer should be knotted or tagged at every 0.5 m to allow fairly accurate width measurements. Tagging can be done with small pieces of tape. Beware of demanding too much data. Enthusiasm varies inversely with the number of measurements required.

The compass measurements can be used to position each section of the map accurately on the mural. Directional and scale errors will immediately become obvious when the pieces are matched together and can be corrected at this stage. Each section should be numbered to get the correct order for matching. The map can be mounted on a wall in the classroom to allow constant reference and for additions and corrections as the unit proceeds. By now a few landmarks will have become important reference points and appropriate names will probably emerge. These names will also make interesting additions to the map.

A Leaf's Journey

This activity should be begun as far up the stream as possible. Perhaps, where the group chooses to start the journey the water is moving relatively slowly. In fact, it may appear that it isn't moving at all. By dropping a leaf into the water, you can find out if it moves.

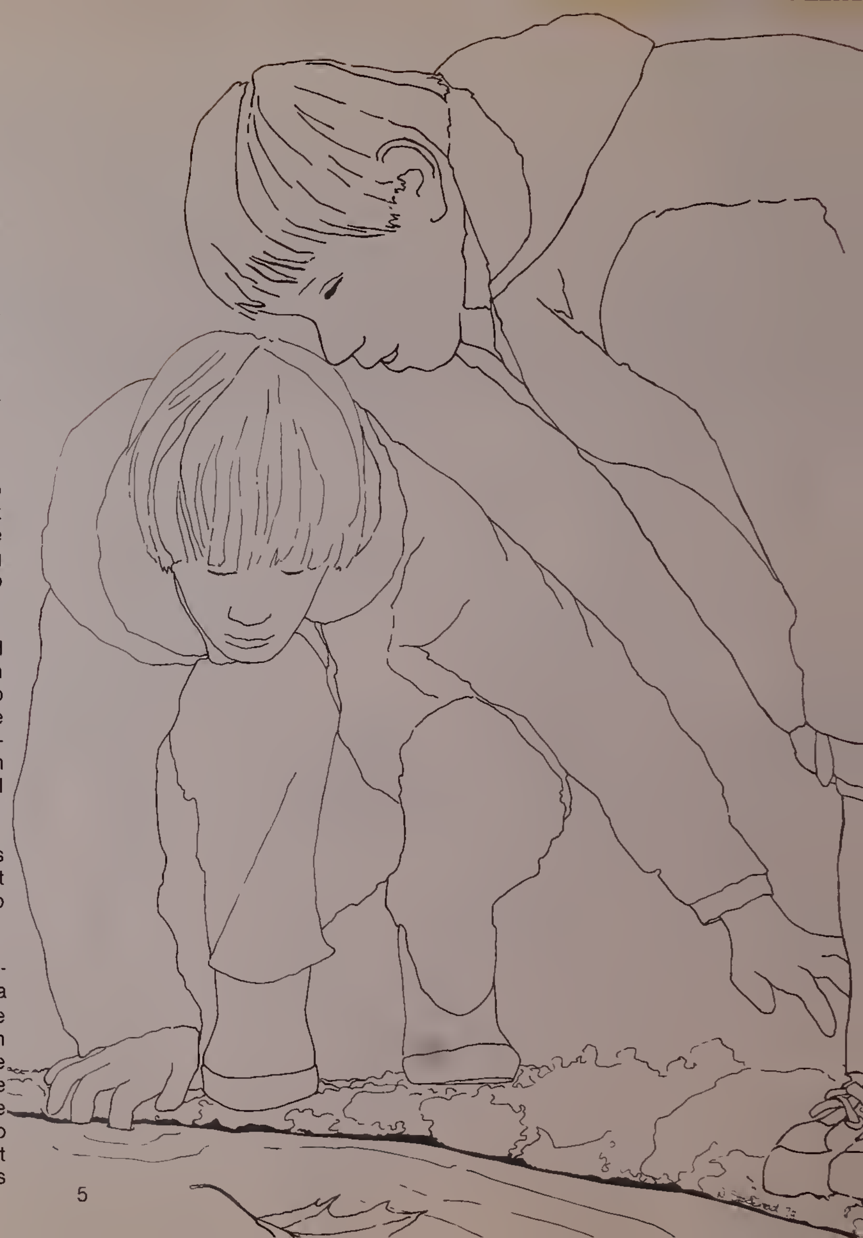
Trying to follow the leaf all the way down the stream is an activity that the children thought of themselves and as a result, they seemed to enjoy it even more. A short distance down stream, the leaf may pick up speed. This causes great excitement. The discovery of the effects of waterfalls, dams and whirlpools on the leaf's course will also generate enthusiasm.

The leaf's journey will clearly show how the speed changes along the creek. The children will be able to remember specific places where the leaf travelled at unusual speeds. They will be able to recall where it went the slowest and the fastest and will be interested in measuring the speed at these places. You should encourage them to suggest ways to do it.

One way to measure speed is by using a 4 m knotted string measurer and a stop watch or an ordinary watch with a second hand. Find out how long it takes for the leaf to travel the length of the string. There are several possible sources of error here. Children tend to give the leaf a send-off push. They also shorten the string by winding 20 - 30 cm of it around their hands or they fail to hold the string parallel to the leaf's path down the stream.

Encourage them to measure creek speed at the places they choose from their experiences with the leaf. Suggest they average three measurements at each location to help reduce the error.

Kids will often ask "How can the speed be different at different places?". The answer to this may be discovered by a series of measurements. At a place where the speed is quite fast, have the children measure the width and depth. Again average three measurements at different locations. Measure again at a slow place. By studying these measurements, the children should conclude that the speed changes because at wider and deeper places the water has more room to spread out so more can move through at once. Therefore, it can go slower and still keep up with the rest. These aspects



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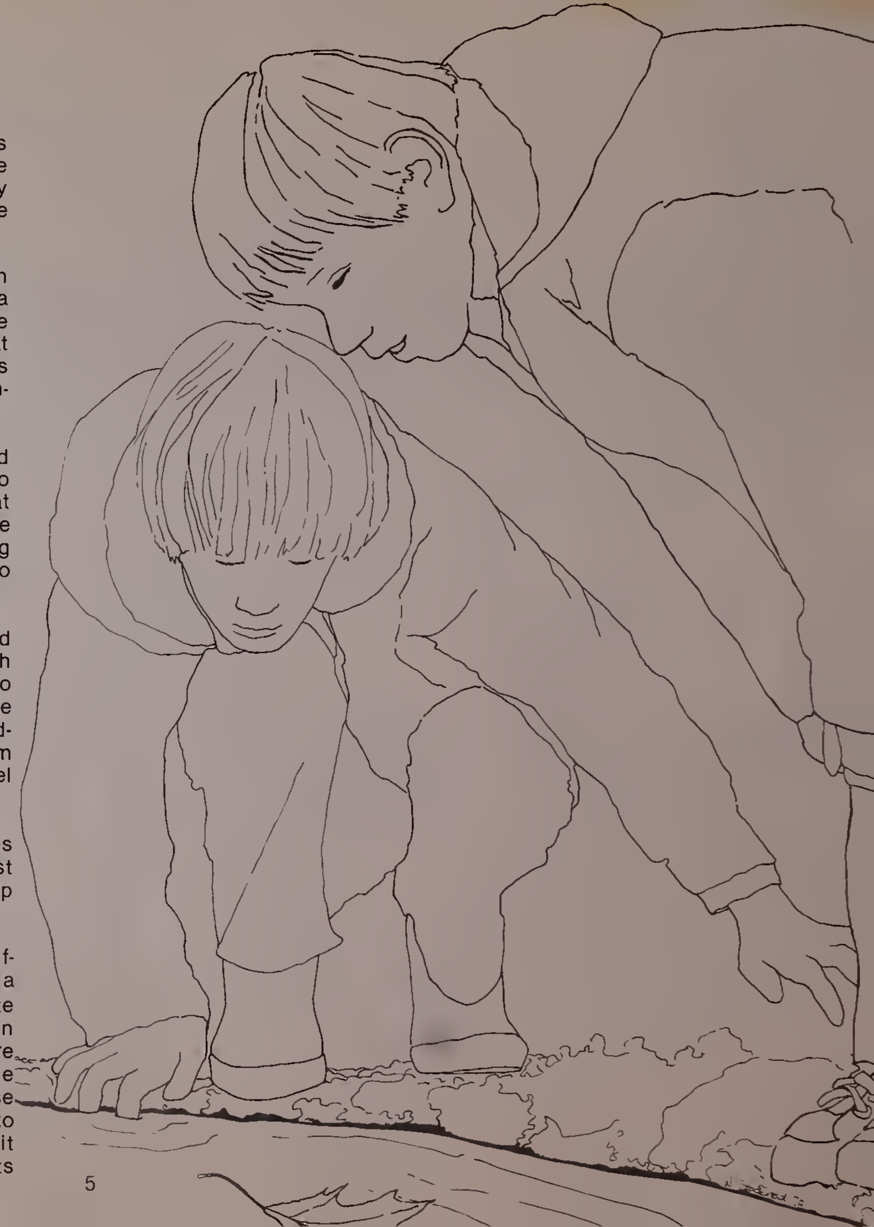

of the creek are dealt with in more detail in the activity "Doing a Creek Profile Study".

The creek map made earlier will be very useful here for recording unusual water flow speeds. By looking at the map, predictions can be made about what the speed would be like at certain places.

Bridge Building

The only classroom materials which we have found necessary for bridge building are plenty of string and a pocket knife for each pupil.

To build a bridge over a creek, there are several questions which must be taken into consideration.

- Where is the creek bed supportive enough?
- Where is the current slow enough but the creek bed narrow enough for the construction to be feasible?
- How does the water level fluctuate?
- Where is there most need for a bridge?

All of these questions must be answered before construction can begin. There should be plenty of natural materials around that can be used for building, without destroying any living plants. The bridge might be built as a miniature of a large bridge over a large river. Therefore, the relative depths that pilings can be driven in must be taken into consideration. Research is required here. You may wish to build a bridge in the classroom and re-assemble it at the creek. After the exercise, the class may wish to leave the bridges to collapse by themselves to see which is the most successful structure, or they may wish to take them apart and restore the environment to its natural state. However, it should be a meaningful lesson to see which bridges withstand the durability test and to discover where weaknesses lie.

To see that a shaky bridge has disappeared a couple of days later will lead to a second attempt resulting in a much more sophisticated and durable structure.

Children usually want to solve the bridging problem by laying a log across the creek. If you wish to make it a more interesting and challenging experience, you can limit the length and width of the materials to be used. One approach that has proven fairly effective has been to limit the diameter of sticks to the thickness of a child's thumb and the length of the span from his fingertips to his elbow. This way everyone has a readily available standard. However, with this limitation suggested before construction begins, children often automatically choose sticks as the only or main material. You can suggest that at least five different materials must be used. This way children may be led to choose fallen leaves, rocks, mud and anything else they may find.

Many children spend hours of their own time building bridges over creeks. An activity like this, structured as a learning situation, can only serve to make school a more enjoyable place.

Building Dams

Lead the children to consider as many factors as possible before choosing the dam site. First, carefully measure the water speed, width and depth at the dam site. Note also the nature of the creek bed. The dam can be constructed of earth, stones and branches which should be returned to their original locations afterwards. After the dam is constructed, have the children measure the water speed on top of the dam, on the spill and below the dam once again.

- Where does it run fastest?
- How have the width and depth changed above and below the dam?
- How does a dam work?

The children will be able to answer all of these questions from observations on their own dams.

Can the children completely stop the creek? How much can they slow it down? These are challenges that are quickly and enthusiastically accepted. If more than one dam is built, the contest is on.

Before leaving the site, take the top dam apart and watch what happens as the backed up water approaches the lower dams. What is the effect of a sudden increase in water flow on the strength of a dam?

If it is possible, leave one dam in position for a few days. It can become the site of a complicated construction of canals, dikes, and irrigated minifields, which can be built during subsequent field trips.

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Building Dikes

Return to the site of the dam constructed earlier. A few repair jobs may have to be performed before any further construction can get underway.

To build dikes, find a good place to reclaim some of the creek bed for "cultivation". This can be accomplished by a series of dikes along each side of the flow. The result will be a narrow canal down the centre of the creek bed between the two dike walls. The dikes must be durable enough to withstand the water, and so their construction must be carefully considered.

- What is the best way to build the dikes so that the water doesn't beat directly on them?
- What is the best material to build with?
- Would sand be better than clay?

All of these questions must be considered before the children begin. After the dike is built, the enclosed water will have to be removed by bailing.

Water Wheels

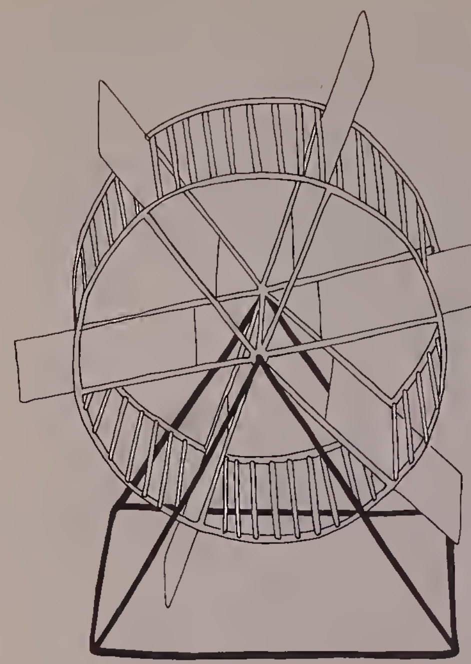
A working paddle wheel can be constructed from an animal activity wheel by taping plastic playing cards to the spokes. To provide handles and allow the wheel to turn, run a long stick through its centre. Children can hang onto the stick, one on each side of the creek as they try to find the best place to harness the water power. This is done by dipping the wheel in the creek at several places, especially above and below the dam and noticing the speed at which the wheel is turning. At the places with the most water power, the wheel will be turning the fastest.

FOR YOUR INFORMATION

A very long time ago, a tribe of people called Frisians lived in the marshes along the coast of Holland. Here the sea rises in winter and floods the flat marsh land. In order to live here, the Frisians built their huts on mounds called terps which they made out of clay, straw and dung. In the summer, they cultivated the bottom area, but in winter they retreated to the terp tops with their cattle while the sea rose around them.

When the Romans invaded, they recognized that the flooded land was immensely fertile. The legions also needed dependable roads that were dry all year round. For these two reasons the Romans built dikes to keep the sea out. The Frisians adopted this idea and diked the land around their terps. They were a scrappy lot and were constantly fighting each other, but whenever a dike was threatened, they all worked together on the repair job. Anyone who refused to work was buried alive at a breach in the dike. Everyone kept the dikes in good repair around his own farm. If anyone failed to do this, he lost his farm to some more energetic person, since one leak would flood a large area.

Dikes were first built of sand and clay but as the sea ate them away, the Frisians learned to bury twigs in them and to plant grasses along the base to hold them together. Dikes sloped slowly to the sea to break the momentum of the waves. Seaweed was mixed in too, because when it was fermented, it hardened into a rock-like mass.



Locks

Many children do not really understand the construction and operation of a lock. A classroom discussion of locks, their location, use and construction will be a very useful way to introduce this activity.

After the children have compared their definitions of what a lock is and how it works, choose a narrow section of a creek with a slight incline and perhaps a few rapids. Supply a small toy boat that floats and odds and ends of boards or sheets of metal and plastic about 30 cm wide and as long or longer than the width of the stream. If there can't be enough material for more than a couple of locks to be built at a time, perhaps this activity should be a small group project.

The task is to float the boat around the rapids or swiftly flowing water. It may be necessary to build a short canal in which the lock will be constructed or the lock can be constructed right over the rapids. The children will quickly discover their own uses for the materials in the construction of a lock. Mud can be used to seal corners and to hold boards upright. The gates can be made of pieces of board which are lifted up manually.

Through this constructive play, the children will quickly pick up an understanding of lock construction. Also their success or failure will be clearly seen when they try to float the boat through safely. As a follow-up, this would be an excellent time for a field trip to a 'real' lock where the children would naturally be interested in inspecting the structure very closely, comparing it with their own lock.

In British Columbia there are operating locks at Castlegar and at the left bank outlet of Cowichan Lake on Vancouver Island. In the Seattle area there are locks at the outlet from Lake Washington. There are many locks on the river systems of eastern Canada, those on the St. Lawrence Seaway being of particular interest.

FOR YOUR INFORMATION

A lock is a box shaped dam that can open at both ends. A ship goes in at the down stream end and the gate closes behind it. Then the up stream gate opens enough to let water slowly fill the lock until the water level is raised up to the height of the water in front of the lock. When it is level, the up stream gate opens to allow the ship to float away safely beyond waterfalls and rapids.

Building Dikes

Return to the site of the dam constructed earlier. A few repair jobs may have to be performed before any further construction can get underway.

To build dikes, find a good place to reclaim some of the creek bed for "cultivation". This can be accomplished by a series of dikes along each side of the flow. The result will be a narrow canal down the centre of the creek bed between the two dike walls. The dikes must be durable enough to withstand the water, and so their construction must be carefully considered.

- What is the best way to build the dikes so that the water doesn't beat directly on them?
- What is the best material to build with?
- Would sand be better than clay?

All of these questions must be considered before the children begin. After the dike is built, the enclosed water will have to be removed by bailing.

Water Wheels

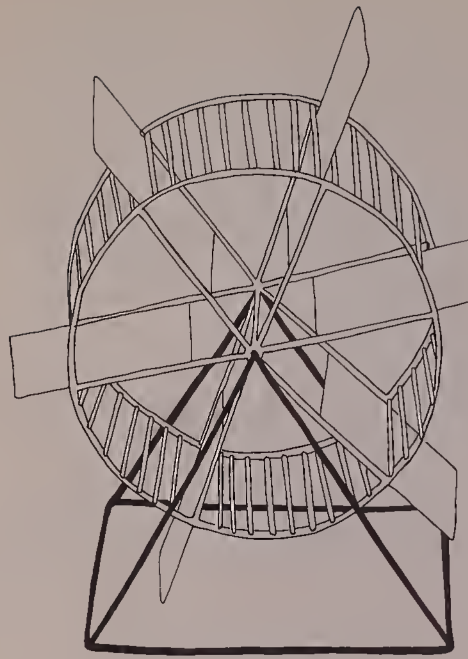
A working paddle wheel can be constructed from an animal activity wheel by taping plastic playing cards to the spokes. To provide handles and allow the wheel to turn, run a long stick through its centre. Children can hang onto the stick, one on each side of the creek as they try to find the best place to harness the water power. This is done by dipping the wheel in the creek at several places, especially above and below the dam and noticing the speed at which the wheel is turning. At the places with the most water power, the wheel will be turning the fastest.

FOR YOUR INFORMATION

A very long time ago, a tribe of people called Frisians lived in the marshes along the coast of Holland. Here the sea rises in winter and floods the flat marsh land. In order to live here, the Frisians built their huts on mounds called terps which they made out of clay, straw and dung. In the summer, they cultivated the bottom area, but in winter they retreated to the terp tops with their cattle while the sea rose around them.

When the Romans invaded, they recognized that the flooded land was immensely fertile. The legions also needed dependable roads that were dry all year round. For these two reasons the Romans built dikes to keep the sea out. The Frisians adopted this idea and diked the land around their terps. They were a scrappy lot and were constantly fighting each other, but whenever a dike was threatened, they all worked together on the repair job. Anyone who refused to work was buried alive at a breach in the dike. Everyone kept the dikes in good repair around his own farm. If anyone failed to do this, he lost his farm to some more energetic person, since one leak would flood a large area.

Dikes were first built of sand and clay but as the sea ate them away, the Frisians learned to bury twigs in them and to plant grasses along the base to hold them together. Dikes sloped slowly to the sea to break the momentum of the waves. Seaweed was mixed in too, because when it was fermented, it hardened into a rock-like mass.



Locks

Many children do not really understand the construction and operation of a lock. A classroom discussion of locks, their location, use and construction will be a very useful way to introduce this activity.

After the children have compared their definitions of what a lock is and how it works, choose a narrow section of a creek with a slight incline and perhaps a few rapids. Supply a small toy boat that floats and odds and ends of boards or sheets of metal and plastic about 30 cm wide and as long or longer than the width of the stream. If there can't be enough material for more than a couple of locks to be built at a time, perhaps this activity should be a small group project.

The task is to float the boat around the rapids or swiftly flowing water. It may be necessary to build a short canal in which the lock will be constructed or the lock can be constructed right over the rapids. The children will quickly discover their own uses for the materials in the construction of a lock. Mud can be used to seal corners and to hold boards upright. The gates can be made of pieces of board which are lifted up manually.

Through this constructive play, the children will quickly pick up an understanding of lock construction. Also their success or failure will be clearly seen when they try to float the boat through safely. As a follow-up, this would be an excellent time for a field trip to a 'real' lock where the children would naturally be interested in inspecting the structure very closely, comparing it with their own lock.

In British Columbia there are operating locks at Castlegar and at the left bank outlet of Cowichan Lake on Vancouver Island. In the Seattle area there are locks at the outlet from Lake Washington. There are many locks on the river systems of eastern Canada, those on the St. Lawrence Seaway being of particular interest.

FOR YOUR INFORMATION

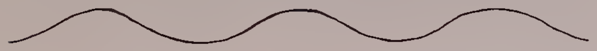
A lock is a box shaped dam that can open at both ends. A ship goes in at the down stream end and the gate closes behind it. Then the up stream gate opens enough to let water slowly fill the lock until the water level is raised up to the height of the water in front of the lock. When it is level, the up stream gate opens to allow the ship to float away safely beyond waterfalls and rapids.

Waves

The artificial lake created above the dam would be a good place to carry out wave studies. If this is not possible, find a place in the creek where the water is very still. A pool in the creek is also ideal for this experience.

How many different ways can the children think of to make a wave? Putting something in the water is the most obvious one. Wind makes waves too. They can create a wind by blowing on the pool.

What is a wave? Is it something that moves? Ask the children to try drawing a picture of waves. Have them look carefully at a series of waves and then diagram what a wave looks like from a side view. They might make a drawing like this:

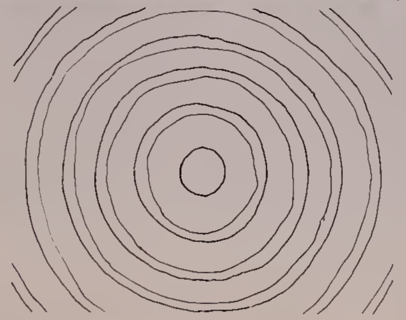


How far is it from the very top of one wave to the very top of the next wave? Can it be measured?

Suggest to the children that they experiment to see how to make this distance longer.

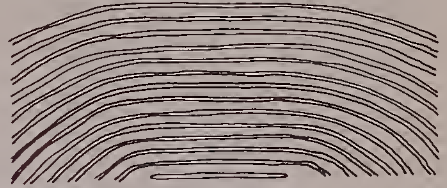
- Can they make it shorter?
- Can they make waves inside waves?
- Where does a wave begin? Where does it end?
- As the wave moves from its starting place to its finishing place, does the water flow with it?
- How can the answer be proven?

Have the children make a point source wave by dipping a finger in the pool or by tossing in a small pebble. Have the children describe and draw the waves which are produced.



- Do they move?
- Which way do they go?
- How do they differ from waves produced by the wind?

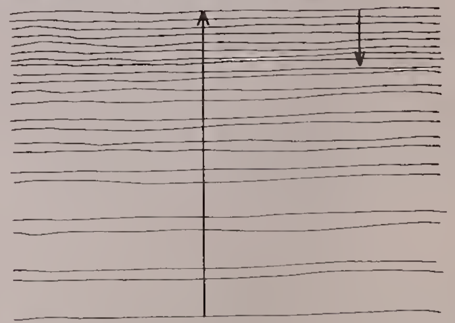
Now have the children put a straight stick in the pool. What does its wave pattern look like? Have the children draw this pattern and compare it with the pattern of the point source waves.



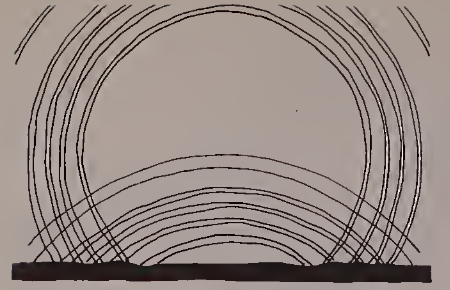
What would the point wave look like in a row with a series of other point waves? Have the children put all ten of their fingertips into the pool in a row. Does the wave pattern look similar to a line source wave? It should. A line wave is just a series of point waves simultaneously formed in a straight line!

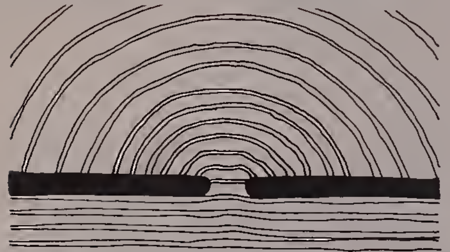
Ask the children to dip two fingers in at the same time about 30 cm apart. Can they describe what happens to the waves when they meet? What happens when the fingers are dipped in one after another? Can they explain the resulting wave pattern?

What happens to a line wave when it bumps into a barrier? Have the children set up a barrier such as a log and observe what happens when a wave hits the log.



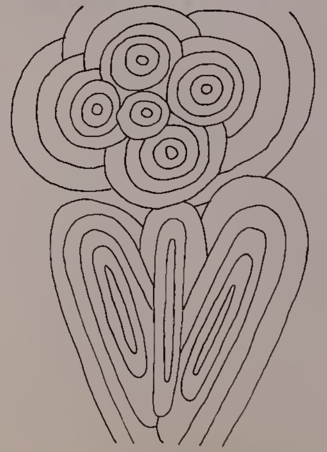
Will a wave go through a barrier? Will it go round it? Try putting in a short barrier and observe what happens when the waves move past it. What happens to the wave if the barrier has a hole in the middle?

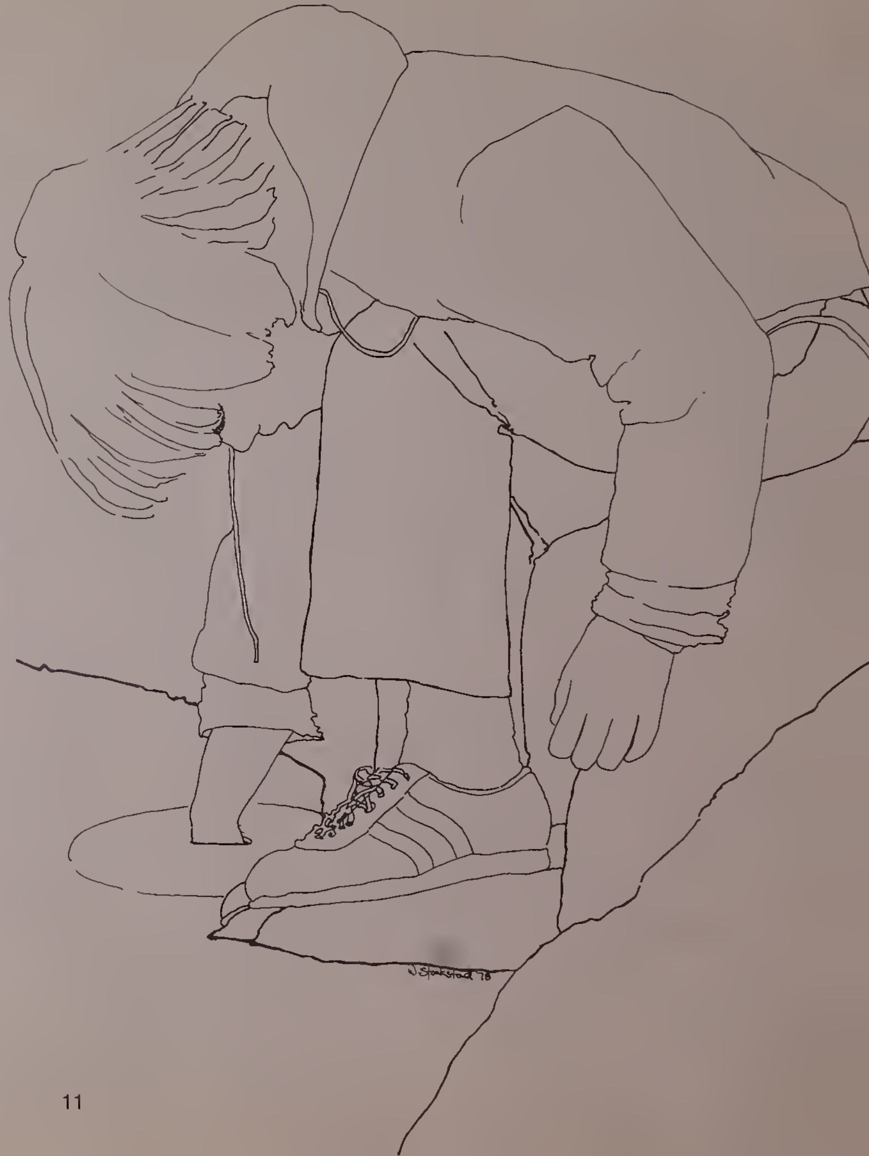




The children often enjoy experimenting with these problems. Now they will be able to make wave pictures. They will only last for a second, so watch carefully. Can you make this one?

This picture was made by simultaneously dropping into the water five pebbles, a long stick and two short sticks.





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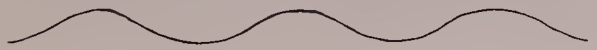

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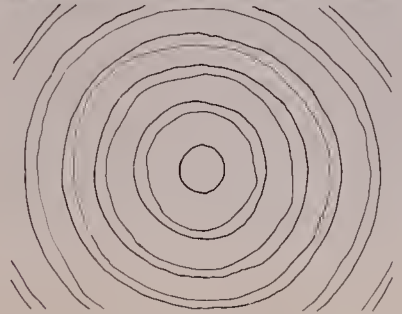

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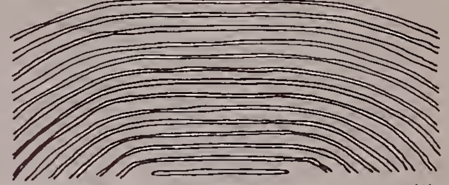

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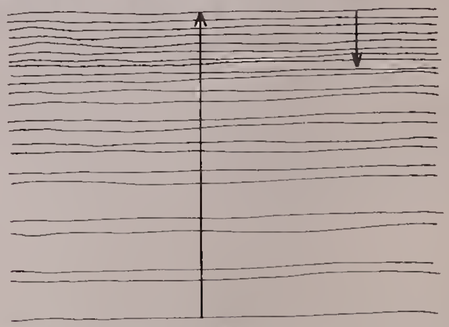

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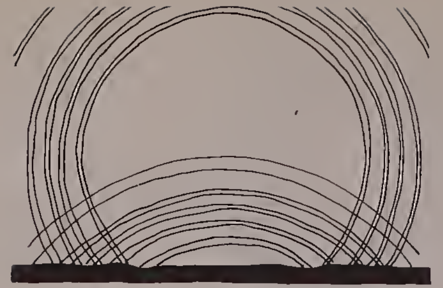

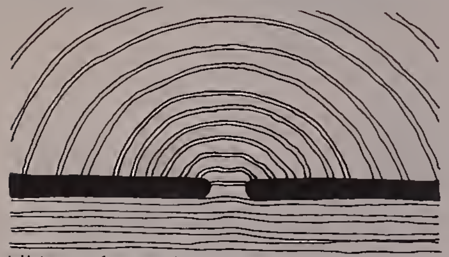

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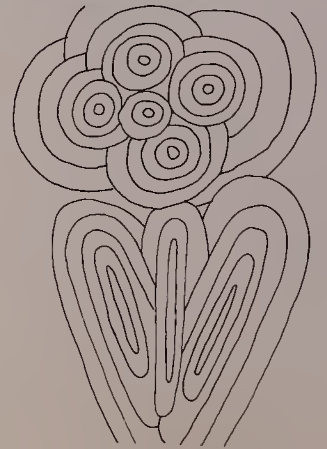

Water Volumes

How much water is in the pond which has formed above the dam?

Can the children find out how much water this pond holds at any one time? The width can be found by averaging several measurements taken with a string measurer at different places across the pond.

A BRAIN TEASER

How many packages of koolaid would it take to make the pond into koolaid?
How much sugar would you need? (using 125 g sugar per package)
How fast would the koolaid be spilling out of the pond?
How long would it be before all of the koolaid is washed away?
One cubic metre holds one thousand litres of water. One package of koolaid is required for each two litres of water.

Finding the average depth is a little more difficult. Have the children stretch the string measurer across the pond at about the middle. Hang a plumb line with a rock at the bottom from the centre of the string. Every 5 cm of the plumb line should be dyed a different colour, or tagged with coloured tape. In this way, the depth can be measured. When the rock is on the bottom of the pond, the line will stop pulling in the same way that a weighted fishing line goes slack when the weight touches the bottom. An average of at least ten measurements should be taken to determine the overall depth accurately. Some measurements should be taken in the centre of the pond so that at least one will be at the deepest part.

Similarly , the width of the pond can be measured, averaged and recorded. The children will have to define carefully where the pond begins to determine the length of the pond.

Although water is constantly flowing through the pond behind a dam, a fixed amount will be there all of the time.

The volume* can be calculated from:

average width in metres × average depth in metres × length in metres = volume in cubic metres (m^3)

Observing below the creek surface

The space between the bottom of a creek and the water surface is an unusual and interesting environment. Many unique plant and animal interrelationships can be studied here.

At least one mask and snorkel with an air mattress can usually be borrowed from class members. Even if these are not available, exciting observations can be made if the bottom is searched with the child's face just above the surface. This activity is suggested only for a warm sunny June afternoon. Suitable attire would be a bathing suit or at least gym strip which can be changed immediately afterwards.

Lying on air mattresses or a constructed platform with their faces just above or submerged in the water is an enjoyable way for children to explore this undersurface world.

What the pupils will see varies from stream to stream, but many of the following questions can be answered:

— How do parts of the stream bottom differ from place to place?
— How would you map the different areas?
— How does the bottom change as you move from shallow to deep sections?
— What is the bottom in the middle of the creek composed of: sand, silt, gravel, or rocks?**
— What is the bottom near shore composed of?
— How deep is the stream in the deepest part?
— What is growing on the bottom?

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- In what areas is it growing?
- How deep is it where these plants grow?
- What is swimming in the water?

The water will probably be shallow enough to allow a sample of bottom plants to be collected and studied closely. Signs of animal life may also be visible, especially if the child lies still for a while. The pupils may be lucky enough to see a school of fish feeding on the plants they have just been studying.

To identify the plants and animals observed, check the illustrations provided.

Doing a Creek Profile Study

When scientists are called to study the ecology of a creek, they try to obtain as much information as possible about small sections selected at different points on the stream. Such studies are called *creek profile studies.*

It is clear that the types of organisms encountered in a creek will be determined by several easily determined factors:

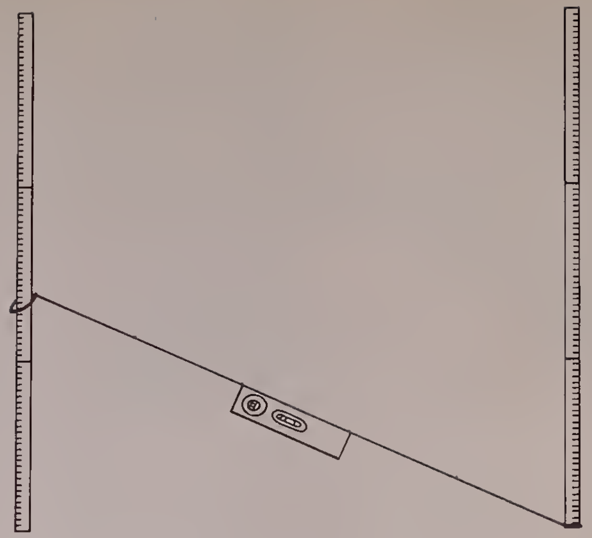
- What is the slope of the creek?
- How do bottom materials vary on the creek bed?
- How does the temperature vary at different places in the creek flow?
- How does the speed of water flow vary from point to point in a creek?

Once this information is collected and graphed, the study team can relate the types of organisms found to conditions in the creek.

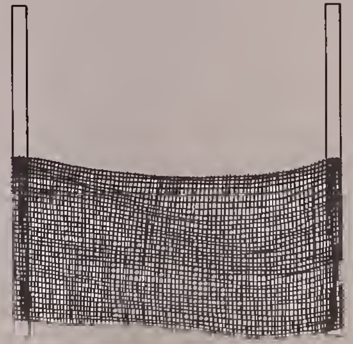
Materials required:

Each team carrying out a creek profile requires:

1. A set of range poles:
   Range poles are used to determine the slope of the creek. Each pole is 3 m long and is graduated into 5 cm intervals. A 3 m rope marked every 50 cm is fixed to the base of one pole and, at the other end, a loop slips on the second pole as in the diagram. Attached to the centre of the rope is a simple carpenter's level.



2. A hand sampling screen:
   Sampling screens can be made easily from two pieces of doweling 1 m long, connected by a strip of metal window screening 60 cm by 60 cm. If metal screening is not available, plastic screening can be used but must be strengthened at the bottom edge by rolling it and then weaving a wire through the roll from one dowel to the other.



3. A Celsius thermometer:
   The best thermometers for the field use alcohol and are protected by a metal casing. Bare glass laboratory thermometers are broken almost immediately under field conditions when children are involved.
4. An aquarium dip net.
5. A stop watch, and 3 m of string attached to a styrofoam ball 2-4 cm in diameter.
6. A plastic bucket and six plastic bags.
7. Hand lenses and if possible, a field microscope.
8. A 30 cm ruler.
9. Graph paper and a clip board.

Creek profile procedure:

We find that the best grouping for creek profile studies is five students to a working group. Each of these groups should have a complete set of equipment as outlined above.

Selecting a site for a creek profile study:

Each group should select a 3 m long creek site for study based on their particular interests. Some groups will want to study the creek as it tumbles through rapids or a low waterfall, others may prefer the slow moving water of a trout pool. Most studies will be made under the normal flow conditions of the creek. Whichever site is chosen, encourage the groups to work at least 25 m apart from each other so some of the sediment and other debris from the disturbed bottom will have a chance of settling out before it reaches the next study site.

Measuring and marking the study site:

Since each group has a set of range poles separated by a rope 3 m long, it can be used to measure the study site. Mark the top end of the site with a fallen branch pushed into the creek bank. Hold one range pole upright at the upper marker and move downstream with the other range pole until the 3 m rope is taut. Mark the lower limit of the study site with another fallen branch pushed into the creek bank.

Three measurements of creek width should be made: at the top, the bottom and at the middle of the study site.

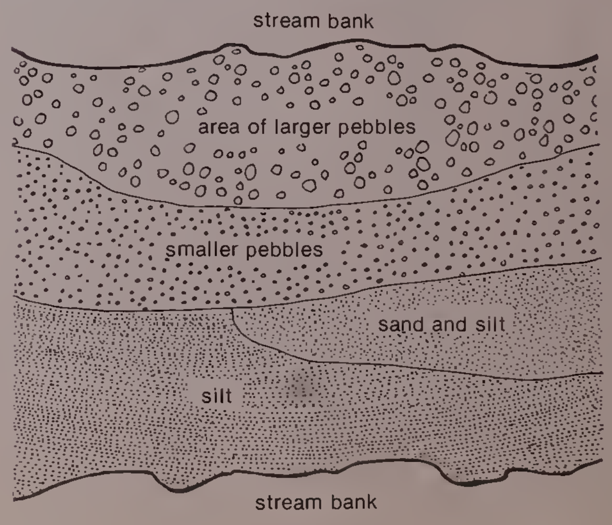
Mapping the site:

When the site has been measured, lay the range poles at the side of the creek so that rope is stretched the length of the study site. The marked rope acts as a handy reference as the features of the site are mapped on graph paper.

Based on the above measurements, make an outline sketch of the creek site. Then add other features such as large rocks and logs.

When students first mapped the creek at the beginning of this unit, they concentrated on the direction of creek flow, features along the creek banks and major obstacles in the creek such as logs. In this study we are particularly concerned with the make up of the creek bottom.

Using the range pole line as a guide, the creek bottom features should be sketched on the map as carefully as possible. The use of symbols to represent the different bottom materials should be encouraged.



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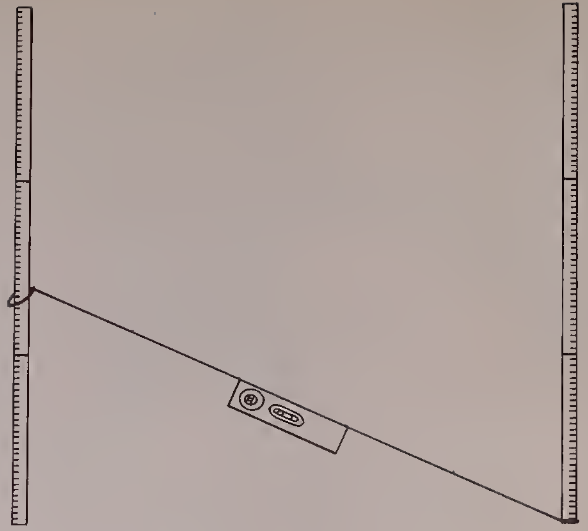

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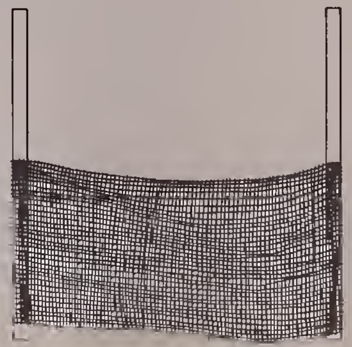

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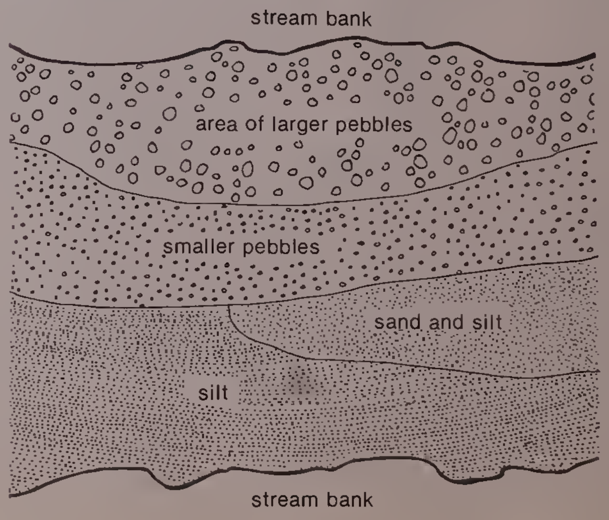
When the site has been measured, lay the range poles at the side of the creek so that rope is stretched the length of the study site. The marked rope acts as a handy reference as the features of the site are mapped on graph paper.

Based on the above measurements, make an outline sketch of the creek site. Then add other features such as large rocks and logs.

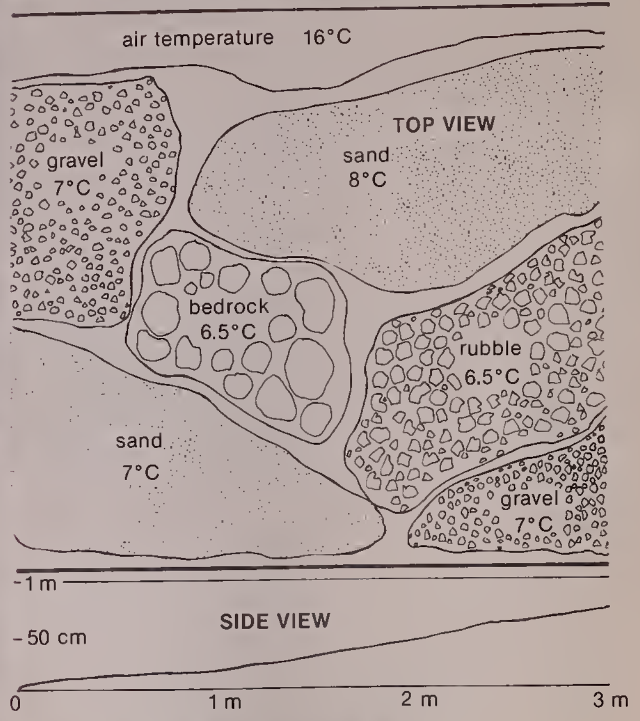
When students first mapped the creek at the beginning of this unit, they concentrated on the direction of creek flow, features along the creek banks and major obstacles in the creek such as logs. In this study we are particularly concerned with the make up of the creek bottom.

Using the range pole line as a guide, the creek bottom features should be sketched on the map as carefully as possible. The use of symbols to represent the different bottom materials should be encouraged.



Taking temperature measurements:

Once the map of your creek site is complete with bottom features, take the water temperature in each of the distinct bottom areas of the site. Mark the temperature at its correct location on the map. If there is only one continuous bottom type, make a water temperature grid. Take the water temperature at three locations near the top of the site (in the middle and 30 cm from each of the two banks); at three similar locations halfway down from the top; and at the corresponding locations at the bottom of the site, (see the accompanying diagram). The air temperature should be taken and recorded for comparison purposes.



Taking water depth measurements:

Using the 30 cm ruler, water depth measurements should be taken at every location sampled for water temperature.

COMMON CREEK BOTTOM MATERIALS:

Bedrock:	Expanses of smooth or rough rock exposed to the creek flow. Bedrock is typical of exceptionally fast moving sections of creeks where the speed of flow is sufficient to carry away even the largest boulders.
Rubble:	Mixed boulders, rocks, and pebbles as large as 30 cm and as small as gravel size (1-2 cm). Rubble is typical of very fast moving creeks.
Gravel:	Gravel contains rock particles up to 2 cm in diameter. It may be mixed with rubble, sand or silt, depending on variations in flow speed. Most mountain creeks have patches of gravel forming important features of the bottom. Though the speed of flow over gravel is not as fast as the above two bottom types, nevertheless, water flow can be very fast indeed.
Sand:	Sand is finely ground rock which is gritty when rubbed between the fingers. Sandy bottoms are typical of back eddies and along the edges of creeks in shallow and slower water than the main channels.
Mud or silt:	Silt is extremely fine rock material with particles so small that it feels smooth when rubbed between the fingers. Mud is usually a mixture of silt and organic soil from the creek banks. Both are typical of the slow moving streams which meander through flat lands.

Depth measurements should be recorded directly on the map at the correct locations.

Taking Water flow measurements:

To make a water flow measurement, unravel the string attached to the styrofoam ball. Tie the end of the string to your finger. Then set the stop watch as you drop the ball in the water. When the string pulls tight, set the stop watch again and record the time in seconds. Always take three measurements at each sampling point. Record the water flow in metres or centimetres per second, at the top of the site map.

Water flow measurements should be taken at several points across the creek depending on its width, water depth and the variations in bottom materials. Begin water flow measurements 30 cm in from the water's edge and proceed across the creek, taking three measurements at each point. If the creek is very narrow, test near each of the banks and in the main channel.

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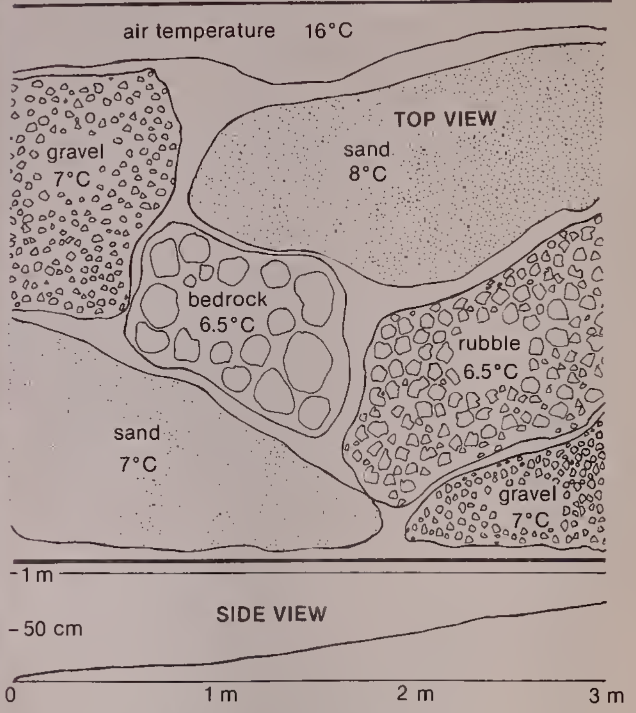

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Determining the slope of the creek:

For this measurement it is necessary to use the range poles again.

Set the "fixed rope" pole at the top centre of the study site. Set the "movable rope" pole at the bottom centre of the study site. Then slide the rope up the bottom pole until the bubble in the carpenters level is at the centre. Once the rope is taut and level, measure the distance up the pole and record the slope in centimetres or metres. Make a sketch of the side view of the creek site beside your site map as in the accompanying diagram.

Working with Creek Organisms

The organisms of the creek form a delicately balanced ecological system. If a large percentage of the plants or animals is removed the creek will change. Besides causing the death of many of the remaining plants and animals it will not be as interesting to other people who come to study it. A general rule for studying the organisms in a creek is to remove as few as are **needed** for study, study them and then return them to the creek. If this rule is followed, the creek will follow its natural cycles and succeeding teachers and students will continue to find it a fascinating experience.

Sampling creek organisms:

The best sampling device for catching small creek organisms is the hand sampling screen. The screen is held across the current at an angle sloping back from the current. A second student disturbs the bottom in front of it so that debris and organisms float back and become lodged on the screen. The screen is then carefully turned horizontally through the current and placed flat on the creek bank. The screen is then examined for movement and all organisms are transferred to a little water in one of the plastic bags. Sample each of the bottom area types and place each sampling in a different plastic bag. Remember to label the plastic bags.

Collect two or three pebbles from each bottom area type and place these in with organisms taken at the same locations. Pebbles can be scraped and the scrapings examined under a microscope at the creek site or back in the classroom. Algae, protozoa, bryozoans, sponges, and attached insects can be identified.

Mosses should be scraped off rocks and placed in bags for examination and identification back at the classroom.

It is not easy to catch the darting fish which inhabit our creeks, but a deft hand with a dip net is often successful if the fish can be trapped in shallow water.

Most fish found in swiftly flowing creeks will soon die in a plastic bag. Identifications should thus be made in the field and the fish returned to the creek. These fish die mainly because of insufficient oxygen, but some cannot tolerate large changes in water temperature, especially warming.

To maintain other collections in the school, a refrigerator is very valuable. Aquatic insects can be kept alive for a long time in a shallow open container in a refrigerator set between 5 and 10°C. The organisms collected at one creek profile site can keep a class busy examining and identifying for a very long time.

Analyzing the results of a creek profile:

Here are some questions which can be asked as the patterns begin to emerge:

- Which animals and plants are found in slow moving water?
- Which animals and plants are found in fast moving water?
- What bottom material was found under the fastest moving current?
- What bottom material was found under the slowest current?
- If the speed of flow decreased, which animals or plants would disappear?
- How are organisms, collected in quiet pools, different from those collected in ranging torrents?

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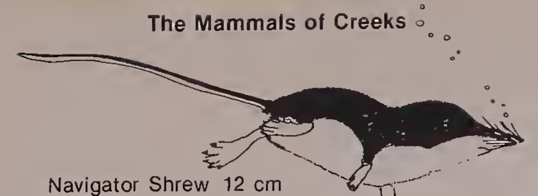
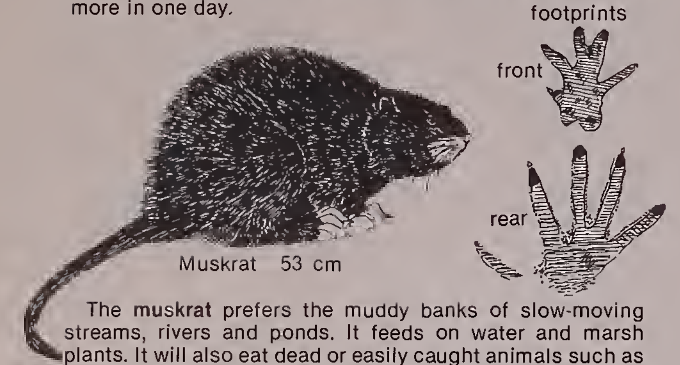
The Mammals of Creeks


Navigator Shrew 12 cm

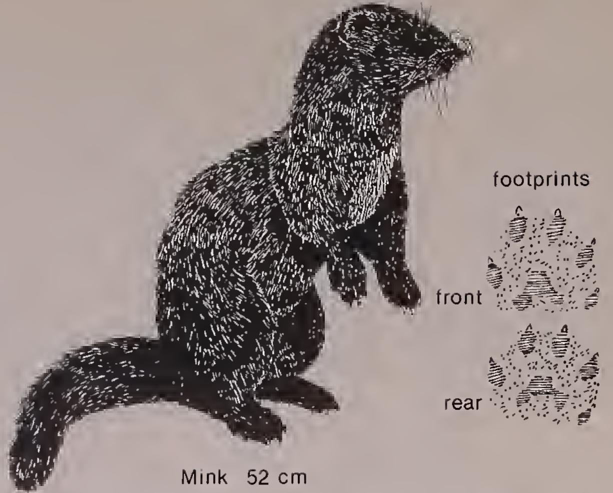
Perhaps the most interesting but also the least often seen creek mammal is the small **navigator shrew**. This shrew feeds in creeks and at the margins of ponds. It feeds almost exclusively on creek insects and fish. An expert swimmer, the navigator shrew is often able to out-swim even the fastest of the creek fish by doggedly pursuing them. Like all shrews, the navigator must feed every twenty minutes or so, in order to stay alive. It is known to eat twice its weight or more in one day.



Muskrat 53 cm

The **muskrat** prefers the muddy banks of slow-moving streams, rivers and ponds. It feeds on water and marsh plants. It will also eat dead or easily caught animals such as fresh water mussels. If the stream bank is high enough, they will begin their burrow under the water and form a large nest above the water in the bank. If the bank is not high enough, they will often make a huge mound of mud and vegetation in which they build their nest. They will even share lodgings with a family of beavers, with whom they seem to be able to co-habit peacefully.

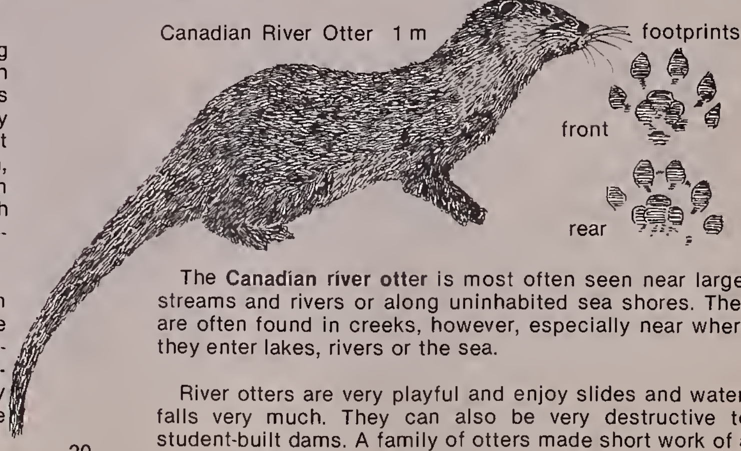
Muskrat watching is a favorite activity of classes in residential camps. Once a muskrat nest is found, the residents can be observed by many groups provided it is approached quietly and the participants are willing to wait patiently for activity to be resumed by the muskrats. Early morning and late afternoons are the best times to observe muskrats.



Mink 52 cm

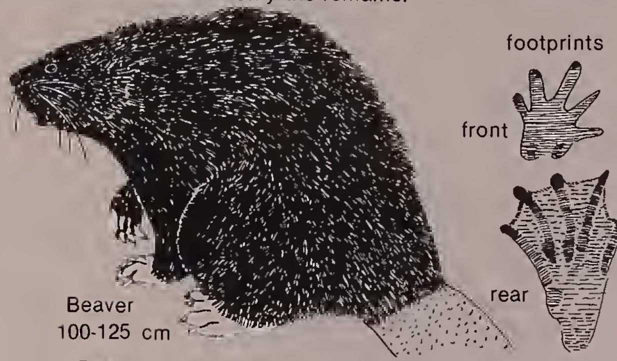
Another shy inhabitant of creek banks is the **mink**. In summer, mink are dark brown except for white patches on their undersides. In winter, their coats turn snowy white. Mink are excellent swimmers and feed mostly on fish. They will also catch birds, muskrats and other mammals. They even love chickens and are infamous for their deadly raids on chicken yards when they kill more than they eat.

Canadian River Otter 1 m



The **Canadian river otter** is most often seen near larger streams and rivers or along uninhabited sea shores. They are often found in creeks, however, especially near where they enter lakes, rivers or the sea.

River otters are very playful and enjoy slides and waterfalls very much. They can also be very destructive to student-built dams. A family of otters made short work of a series of five dams built by several groups of students. They began at the top, swimming rapidly with the current, smashing over and through each dam. Each of the five otters went through the same routine several times until the creek was brown with mud and hardly any evidence other than scattered boulders remained of the dams. The next day, astonished, bewildered and incensed dam builders began to accuse all real or imagined foes until informed of the real culprits. They then tried to build "otter-proof" dams. But river otters are 1-1.5 m in length and often weigh 15 kg or more. The remains of the strengthened dams were more visible but were still only the remains.



Beaver
100-125 cm

Beavers are becoming much more common in creeks and small rivers. They are easily detected because of their habit of damming even the smallest creek to form a large pond. Their dams are exceedingly strong (definitely otter-proof!) and are built of branches interwoven, with the gaps between them stuffed with mud and sod from the creek bank.

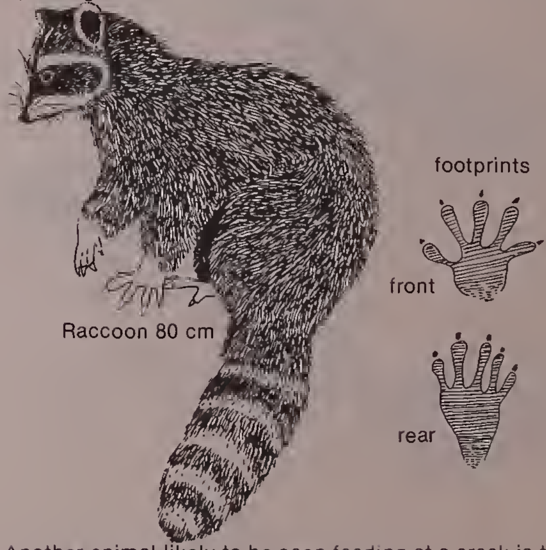
Two obvious signs of beavers are the lodge and dam. Lodges are strongly built of branches, twigs and logs floated into position and woven into a compact dome over the living quarters. Some lodges are 5 m across and almost 2.5 m high from the water to the vent at the top. The entrances are under water and lead onto a raised platform built above the water, with living quarters that are often divided into several rooms. Sometimes these homes are plastered with mud for better insulation. Look for lodges in the pond above a beaver dam.

Beaver cuttings are easy signs to locate. Fallen trees and stumps might show characteristic gnawing techniques — an encircling cut in a deepening groove. Stumps with tooth-marked tops, sections of logs with pointed ends and half-gnawed through areas together with large piles of chips, are easily spotted.

Smooth, white, peeled logs and twigs found on a bank or in water may be the remains of a feed on bark.

A scent mound is a pile of mud scraped together, or a pile of mud, grass and sticks on which a male beaver will leave a strong, pungent odor. These mounds mark the boundary of a beaver's territory and the scent is made to attract a mate. The more elaborate mounds may be over 1 m in diameter and more than 30 cm high.

If a beaver's supply of wood runs low, it will travel a good distance to find more. It will build canals from one area to another to float logs home, and will often leave drag marks on the ground which indicate a path taken while carrying away branches. The drag marks look as if someone had swept the ground with a stiff broom.



Raccoon 80 cm

Another animal likely to be seen feeding at a creek is the **raccoon**. Although a raccoon can catch frogs and fish such as trout and spawning salmon, they are most often sighted at the creek with food they have caught somewhere else. Raccoons have a habit of washing or wetting almost everything they eat. If they catch a snail or a snake, they will carry it to the creek, wash it, then sit and eat it.

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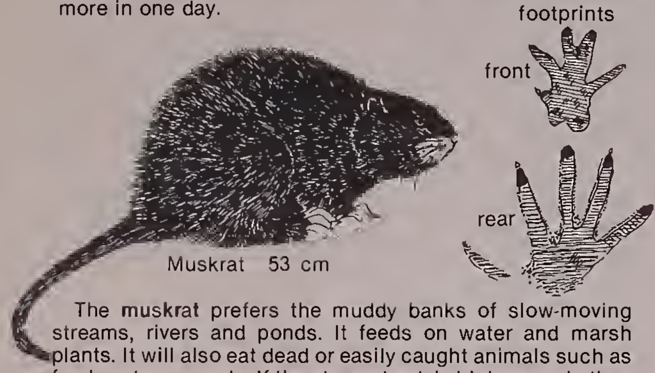

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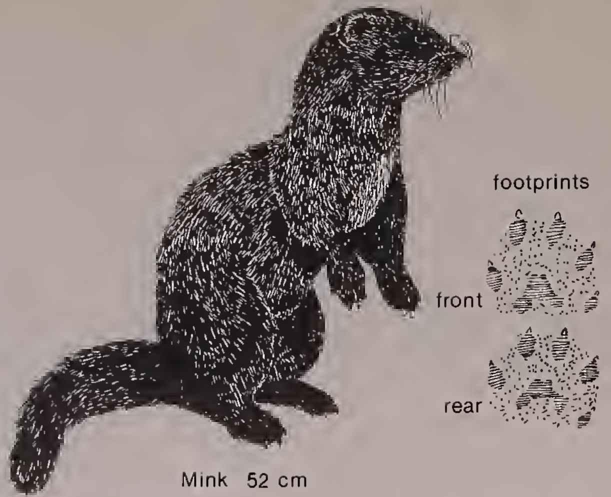

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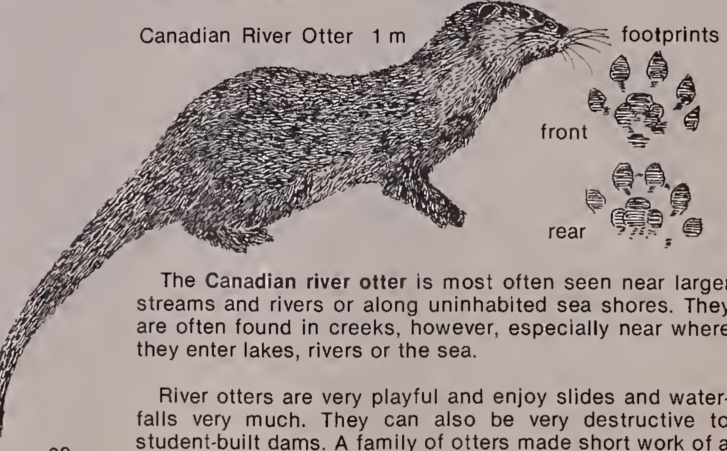

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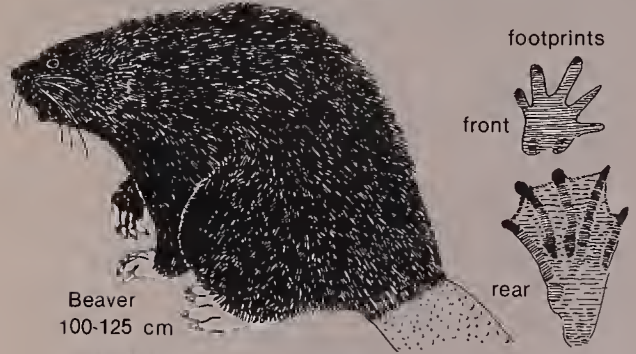

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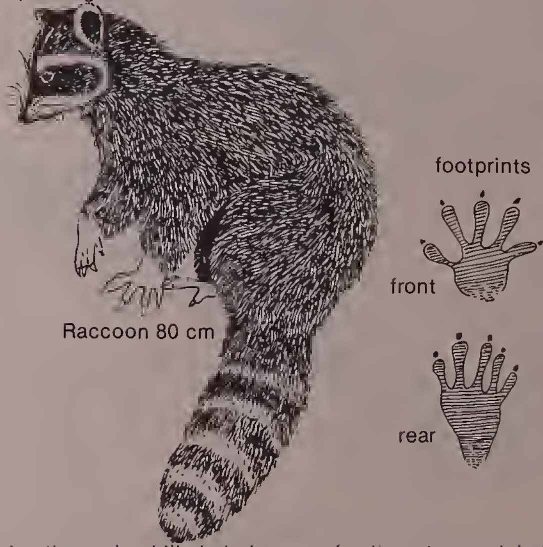

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Dipper (Water Ouzel) 17-20 cm

Kingfisher 28-35 cm

Great Blue Heron 95-120 cm

The Birds of Creeks

The most common bird associated with creeks in western areas is the **water ouzel** or **dipper.** It is also the most interesting. The water ouzel thinks nothing of walking into a creek, feeding on the insects of the creek bottom. What is disconcerting to the novice is the way in which it just keeps on going until it is completely submerged, pecking and scratching away under ten to twenty cm of flowing water. They also swim in the creek using their wings to propel them. Often they will fly full speed into the water and explode out again into the air. More often they pop out of the water, bobbing their heads as they hop along the creek bank or in the shallow water.

Water ouzels are shy and unobtrusive birds and should be watched for in silence. Classes quietly eating lunch beside a creek have often been given a demonstration of the water ouzel's abilities.

You may also be able to watch a **belted kingfisher** feeding at a deep pool or stream. They are unlikely to be seen along a narrow creek in the woods because they need room in which to fly. Kingfishers love space. They hover three to four metres above the pool and when they have spotted their prey, fold their wings and dive straight into the water, often swimming a metre or two under the water to catch a fish. They burst from the water with their fish and continue to fly to a favorite perch with a rattling cry.

Though they are common only on larger streams and rivers, kingfishers are easy to spot, since they announce themselves with such a raucous cry.

The largest bird to feed in creeks is the **great blue heron.** Though it is large, it is very quiet and almost motionless until it strikes its prey. The great blue heron is a very shy bird. It must be approached very cautiously and if startled, will suddenly fly off with a noisy series of squawks.

The great blue heron often feeds while standing motionless on one foot. When it sights a fish it slowly moves its head into striking position and then, like a flash, drives its dagger-like bill into the water, catches the fish and swallows it with a gulp.

Some Activities with Frogs

Frogs, although plentiful enough in and around most creeks, are not always the easiest creatures to find. Patience is certainly a virtue in this type of endeavour, but since there is no guarantee that the search will prove successful, the teacher would be well advised to have several alternate projects ready which can be attempted during the outing.

It has been our experience that, upon finding a frog, the children are generally quite excited, and will often want to grab the animal. For this reason, they should be encouraged to be gentle in handling it during the activities which are described. Here are some things which can be done with frogs.

Have the pupils look at its markings closely and feel how slippery and loose its skin is.

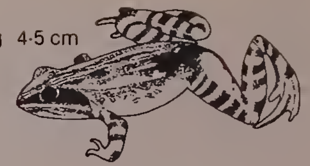
Discuss with them where they found it — on water or land?

Which do they think the frog prefers, land or water? Watch what it does in both of these environments in order to decide. Watch it swim. Notice in particular how the legs are moved. Watch the front legs move. Can the children imitate the movements of the frog?

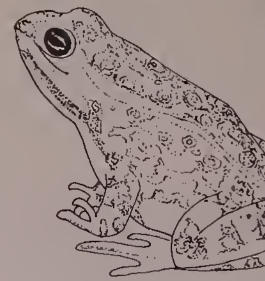
If you have a metrestick with you, suggest measuring how far and how high it jumps. They can measure how fast it swims the same way they measured how fast the creek flows. If two frogs are available, they might like to see which one swims faster, or jumps higher and farther.

Eventually, the children should let their frogs go where they found them. Do they try to hide? Where? Discuss camouflage and how their colour helps them hide.

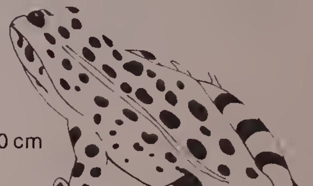
In spring, frog eggs can be found in the still water back eddies of creeks. They look like little blobs of jelly with black dots in the centres. These can be hatched in the classroom if they are kept cool, (below 16°C). Perhaps several trips back to the creek to check their progress in their natural environment would be just as interesting. After hatching, watch closely for the swimming tadpoles. Lying on an air mattress or platform and using a mask and snorkel is an interesting way to observe them.



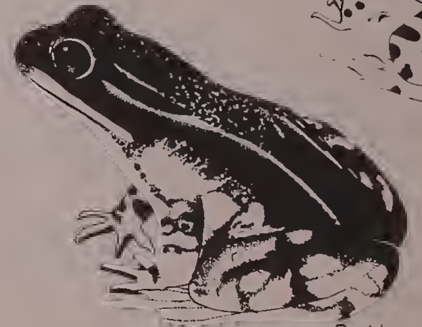
Northern Wood Frog 4-5 cm



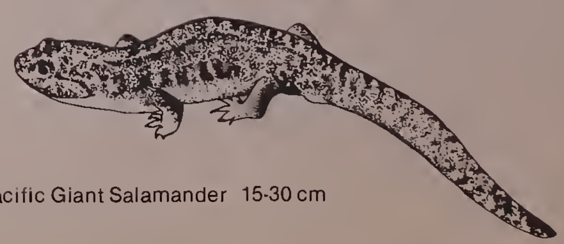
Western Spotted Frog 6-9 cm



Leopard Frog 6-10 cm



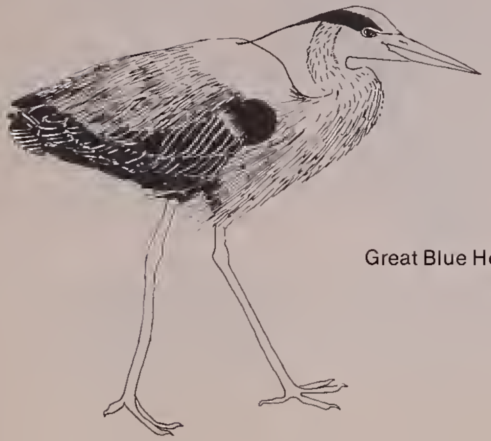
Red-Legged Frog 6-10 cm



Pacific Giant Salamander 15-30 cm

Dipper (Water Ouzel) 17-20 cm

Kingfisher 28-35 cm



Great Blue Heron 95-120 cm

The Birds of Creeks

The most common bird associated with creeks in western areas is the **water ouzel** or **dipper**. It is also the most interesting. The water ouzel thinks nothing of walking into a creek, feeding on the insects of the creek bottom. What is disconcerting to the novice is the way in which it just keeps on going until it is completely submerged, pecking and scratching away under ten to twenty cm of flowing water. They also swim in the creek using their wings to propel them. Often they will fly full speed into the water and explode out again into the air. More often they pop out of the water, bobbing their heads as they hop along the creek bank or in the shallow water.

Water ouzels are shy and unobtrusive birds and should be watched for in silence. Classes quietly eating lunch beside a creek have often been given a demonstration of the water ouzel's abilities.

You may also be able to watch a **belted kingfisher** feeding at a deep pool or stream. They are unlikely to be seen along a narrow creek in the woods because they need room in which to fly. Kingfishers love space. They hover three to four metres above the pool and when they have spotted their prey, fold their wings and dive straight into the water, often swimming a metre or two under the water to catch a fish. They burst from the water with their fish and continue to fly to a favorite perch with a rattling cry.

Though they are common only on larger streams and rivers, kingfishers are easy to spot, since they announce themselves with such a raucous cry.

The largest bird to feed in creeks is the **great blue heron**. Though it is large, it is very quiet and almost motionless until it strikes its prey. The great blue heron is a very shy bird. It must be approached very cautiously and if startled, will suddenly fly off with a noisy series of squawks.

The great blue heron often feeds while standing motionless on one foot. When it sights a fish it slowly moves its head into striking position and then, like a flash, drives its dagger-like bill into the water, catches the fish and swallows it with a gulp.

Some Activities with Frogs

Frogs, although plentiful enough in and around most creeks, are not always the easiest creatures to find. Patience is certainly a virtue in this type of endeavour, but since there is no guarantee that the search will prove successful, the teacher would be well advised to have several alternate projects ready which can be attempted during the outing.

It has been our experience that, upon finding a frog, the children are generally quite excited, and will often want to grab the animal. For this reason, they should be encouraged to be gentle in handling it during the activities which are described. Here are some things which can be done with frogs.

Have the pupils look at its markings closely and feel how slippery and loose its skin is.

Discuss with them where they found it — on water or land?

Which do they think the frog prefers, land or water? Watch what it does in both of these environments in order to decide. Watch it swim. Notice in particular how the legs are moved. Watch the front legs move. Can the children imitate the movements of the frog?

If you have a metrestick with you, suggest measuring how far and how high it jumps. They can measure how fast it swims the same way they measured how fast the creek flows. If two frogs are available, they might like to see which one swims faster, or jumps higher and farther.

Eventually, the children should let their frogs go where they found them. Do they try to hide? Where? Discuss camouflage and how their colour helps them hide.

In spring, frog eggs can be found in the still water back eddies of creeks. They look like little blobs of jelly with black dots in the centres. These can be hatched in the classroom if they are kept cool, (below 16°C). Perhaps several trips back to the creek to check their progress in their natural environment would be just as interesting. After hatching, watch closely for the swimming tadpoles. Lying on an air mattress or platform and using a mask and snorkel is an interesting way to observe them.

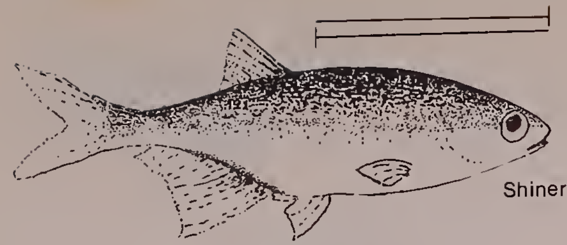
Northern Wood Frog 4-5 cm

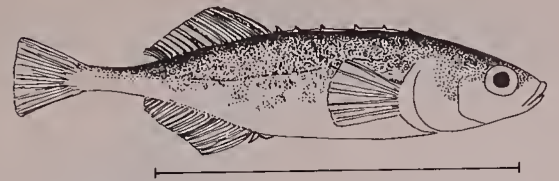
Western Spotted Frog 6-9 cm

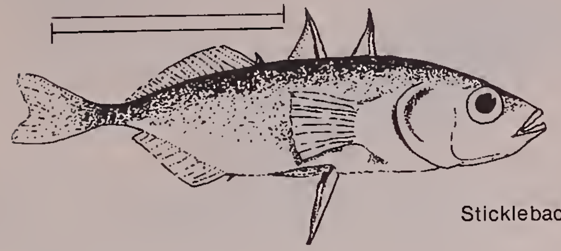
Leopard Frog 6-10 cm

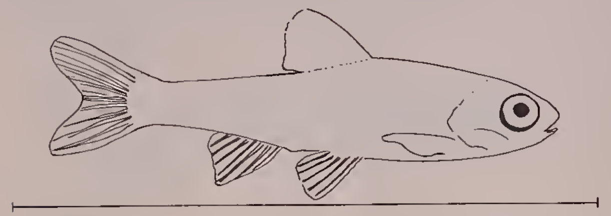
Red-Legged Frog 6-10 cm

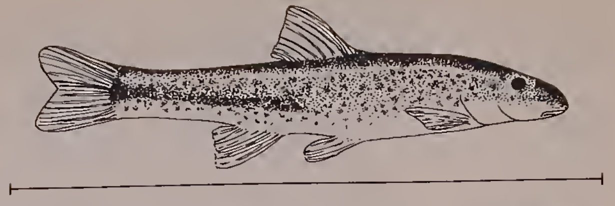
Pacific Giant Salamander 15-30 cm

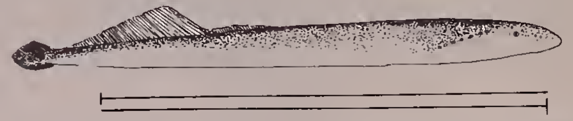

Shiner

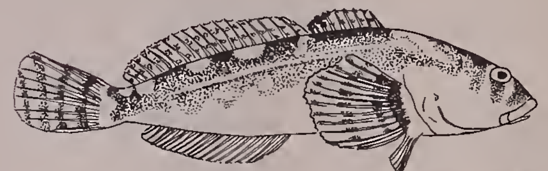

Brook Stickleback

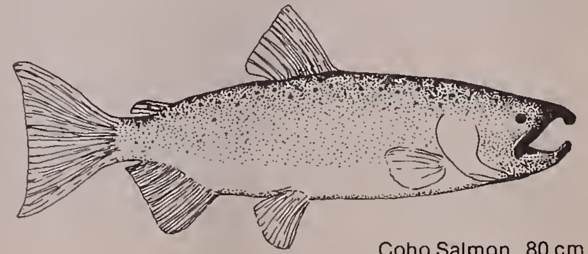

Stickleback


Brassy Minnow


Longnose Dace


Western Brook Lamprey


Sculpin less than 30 cm


Coho Salmon 80 cm

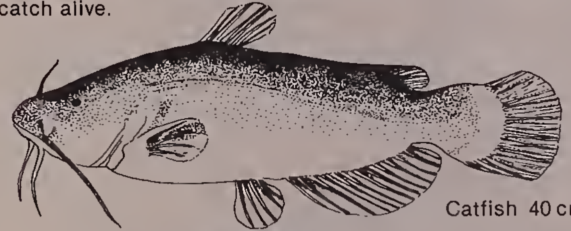
Creek Fish*

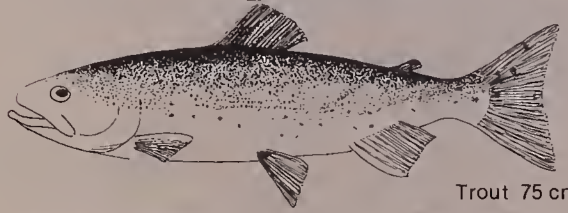
There are two distinct groups of creek fish, depending very much on the speed of flow of the creek and the temperature of the water. The fish of cold, fast moving mountain streams tend to be quite small and very strong swimmers for their size. They include such fish as trout, dace, minnows, sticklebacks and sculpins.

The fish of warmer, slow moving, meandering creeks of the valley bottoms tend to be larger (but there are small species) rather slower moving and very much the same group as are found in ponds. This group of fish also includes minnows, trout, sticklebacks and sculpins as well as catfish, shiners and suckers.

To catch the fish of fast moving streams, one must force them into the shallows and capture them with a dip net. Fine mesh gill nets are also effective. Most of these fish are only rarely caught on a hook. The most obvious exception is the trout, but there are almost always size limitations which must be carefully observed. It is always best to return these fish after examination and identification in the field.

Some of the fish found in slow moving creeks can be caught relatively easily by baited hook and line. Included among these are catfish, trout, and some suckers. The smaller fish can be netted with gill nets, but care must be taken to examine gill nets regularly if you wish to keep the catch alive.


Catfish 40 cm


Trout 75 cm

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*For more information about trout and salmon, see *Small Streams and Salmonid* by C. Dyckman, and S. Garrod (Eds.) Unesco, Paris 1977.

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— between floating leaves and sticks
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— under stones along the shore
— flying over the stream or near it

Examination of the collected specimens under hand lenses and microscopes will allow many questions to be answered that otherwise would have to be overlooked.

Student inquiries with bugs can be guided by a data sheet similar to the sample that follows or perhaps by small group discussions.

A comparison of different data sheets on different insects should be very instructive. Some possible comparison questions are:

— How many specimens were in the adult stage?
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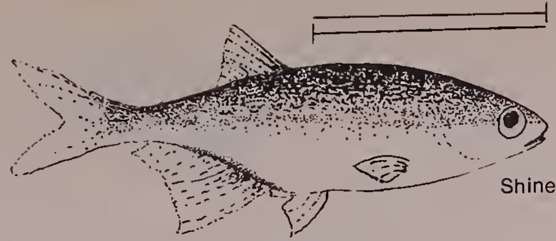
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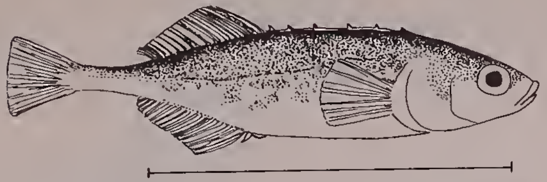
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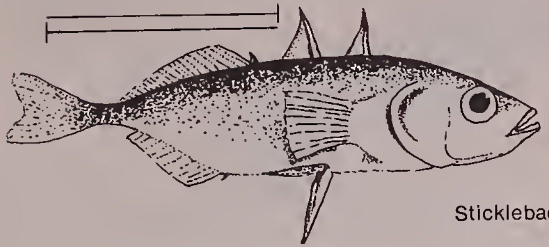
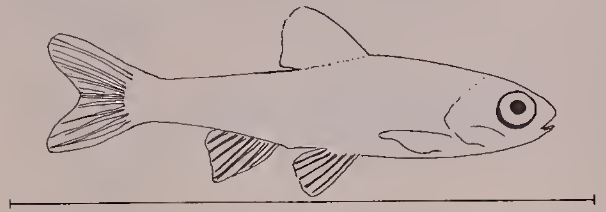

Stickleback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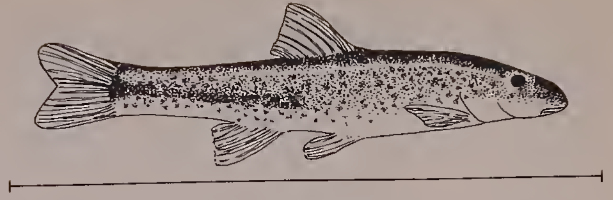
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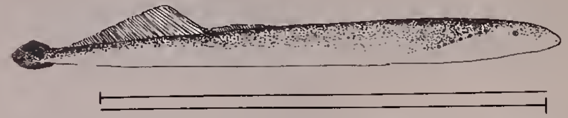
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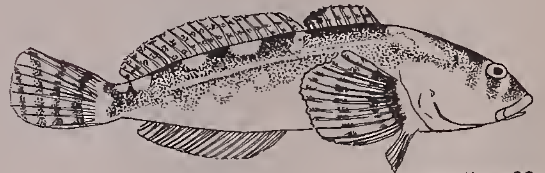
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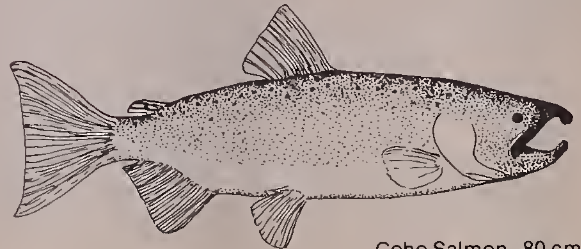
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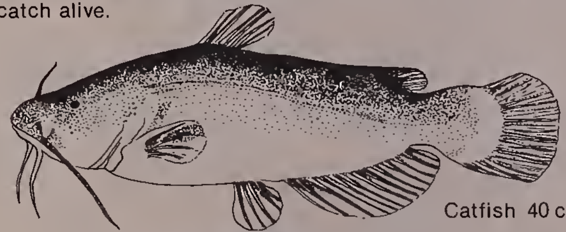
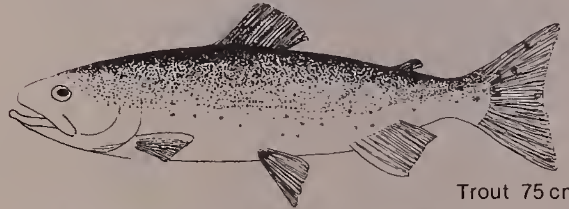

Catfish 40 cm


Trout 75 cm

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WATER BUG DATA SHEET

1. Describe where the bug was found. (If it was found in the water, what part? On the surface? Below the surface? On the creek bottom?) ____________

2. How many other ones like it did you see? ___

3. How fast was the creek moving where the insect was found? ____________

4. What does the bug look like? ____________

   How big is it? ____________

   What colour is it? ____________

   Is it a larva or an adult? ____________

   Does it have any unusual characteristics? ___
   ____

5. How does it behave? ____________

   How does it move? ____________

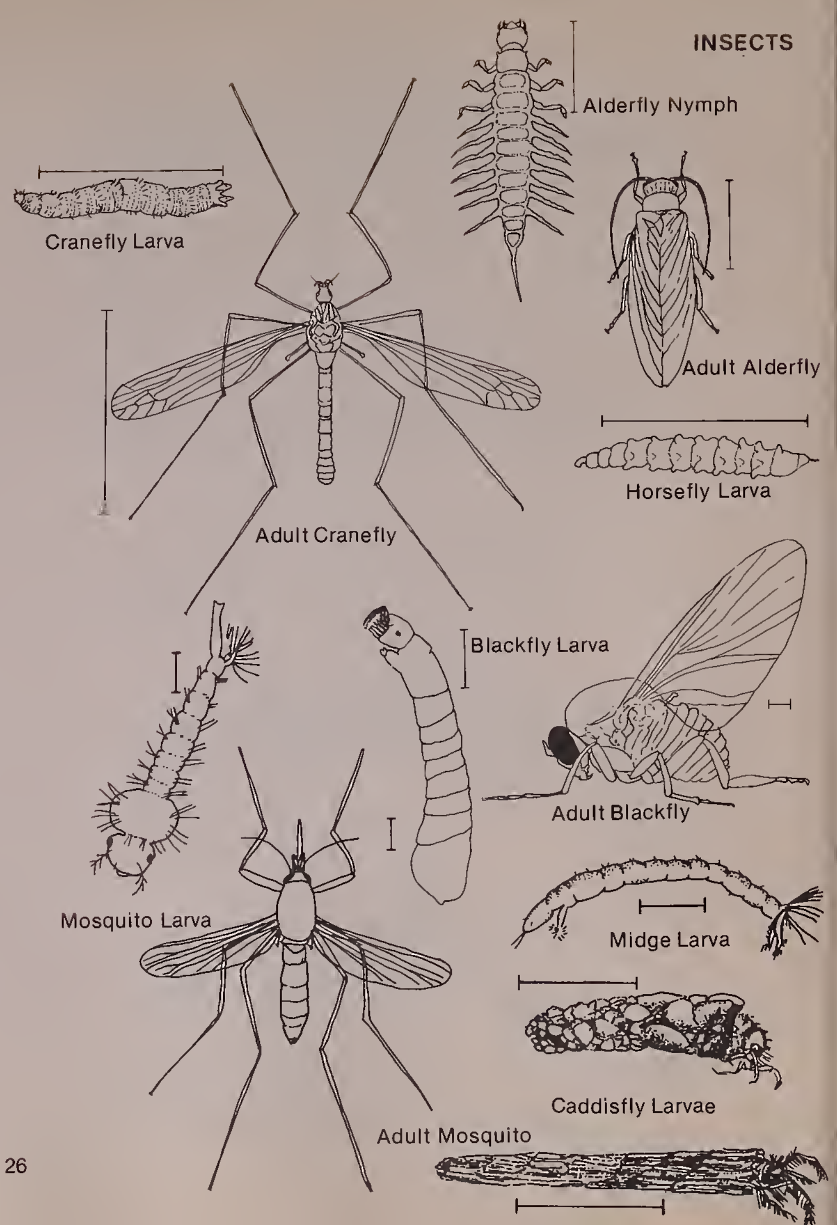
   It is quite active or slow moving? ____________

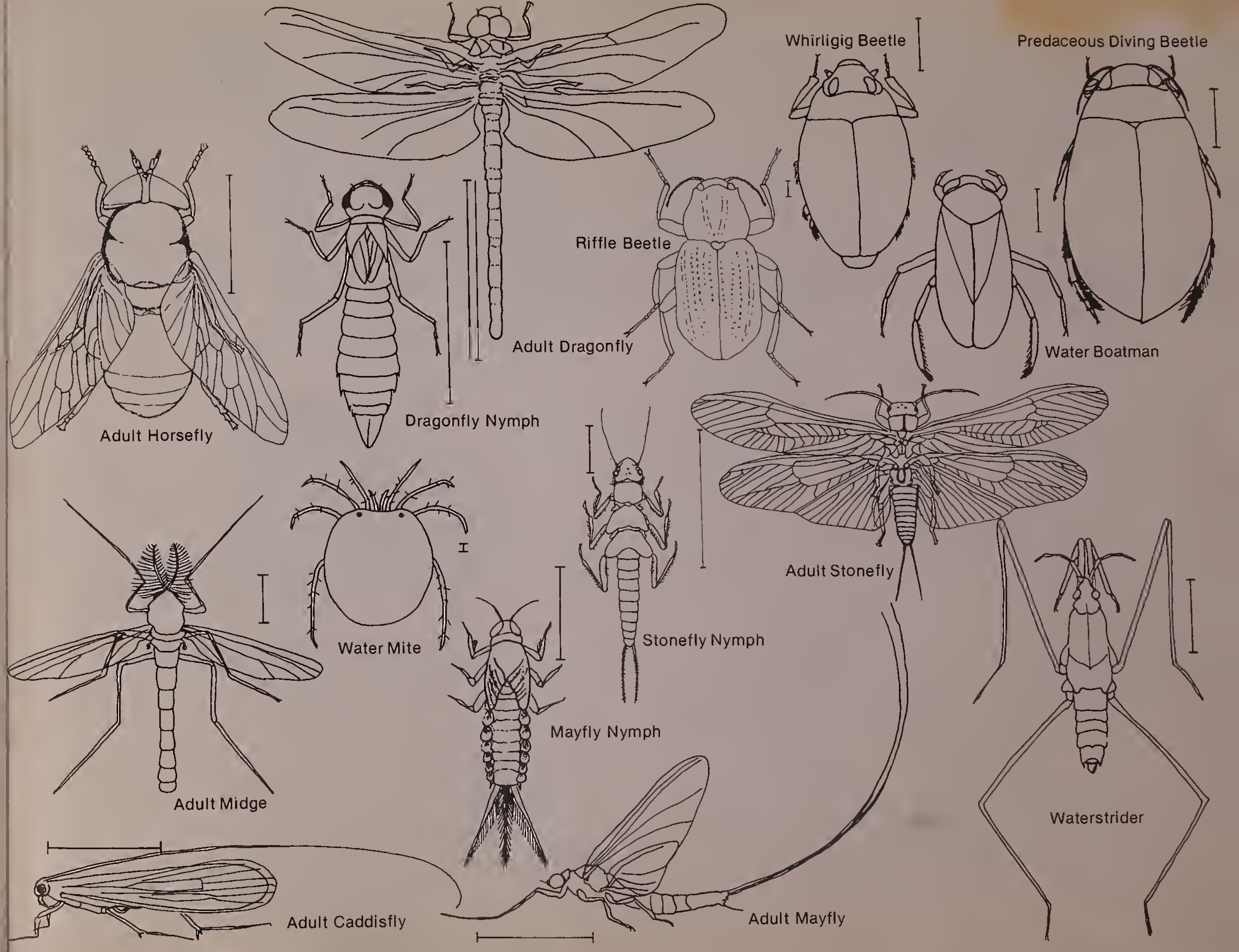
   When you found it, how did it try to escape, or did it? ____________

   How is its body adapted to help it move? ___
   ____

6. What do you think its name is? ____________

INSECTS





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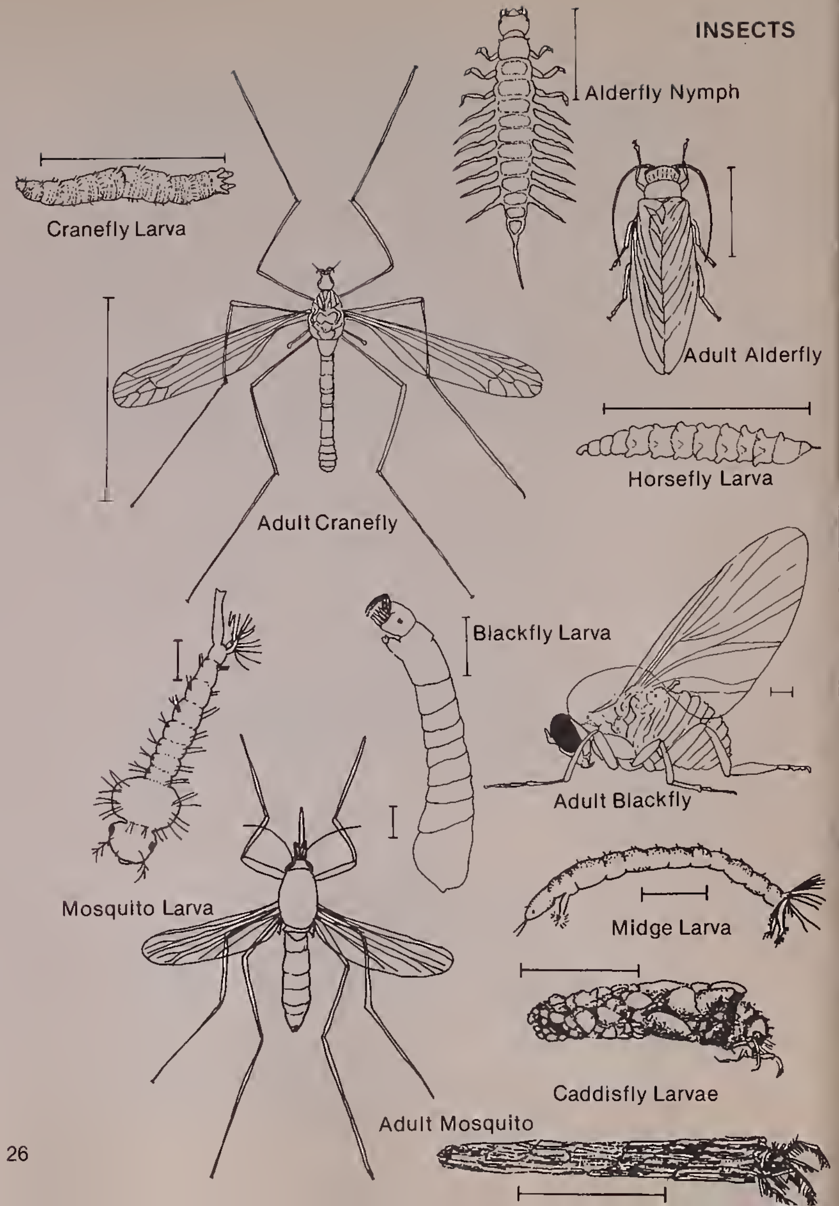
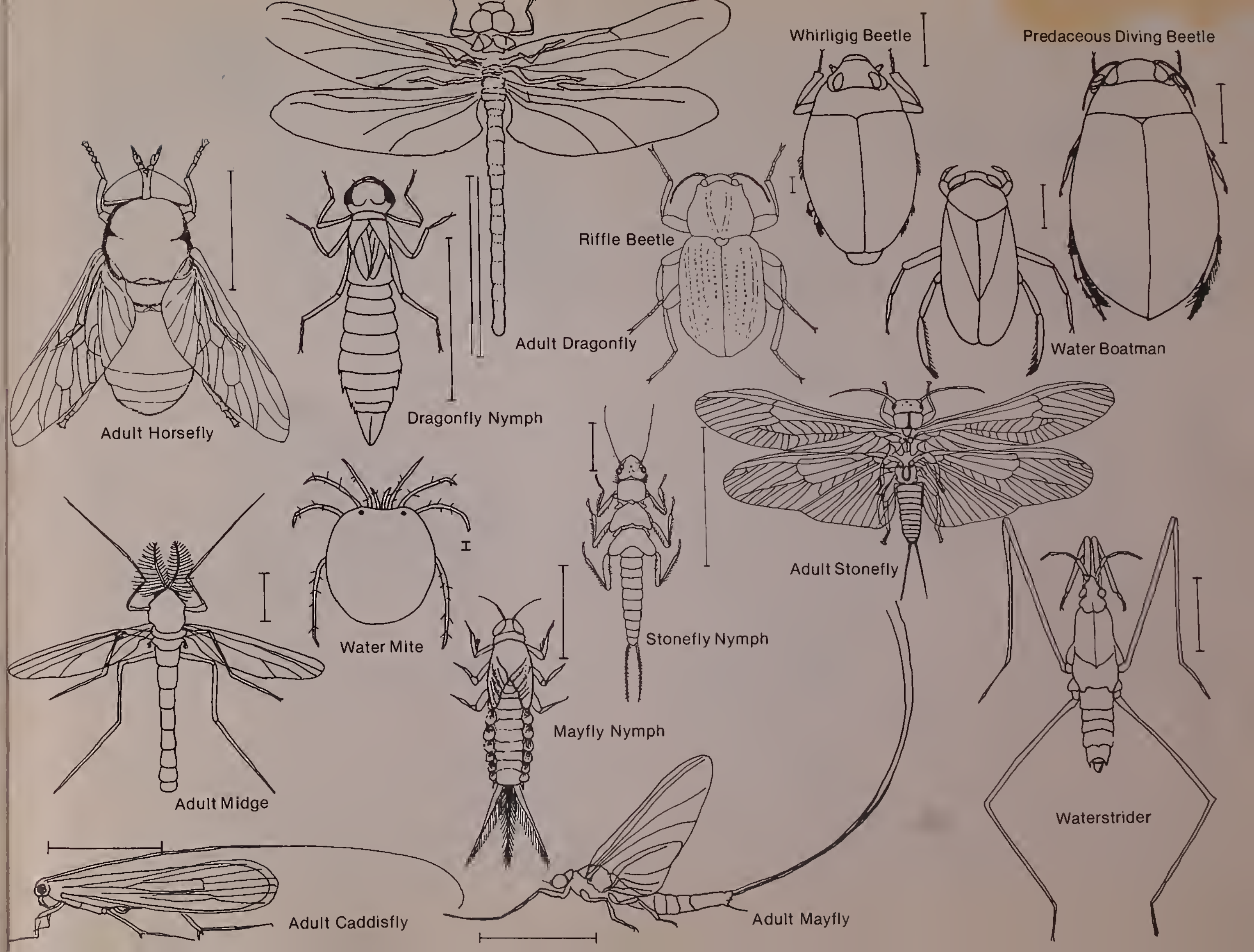
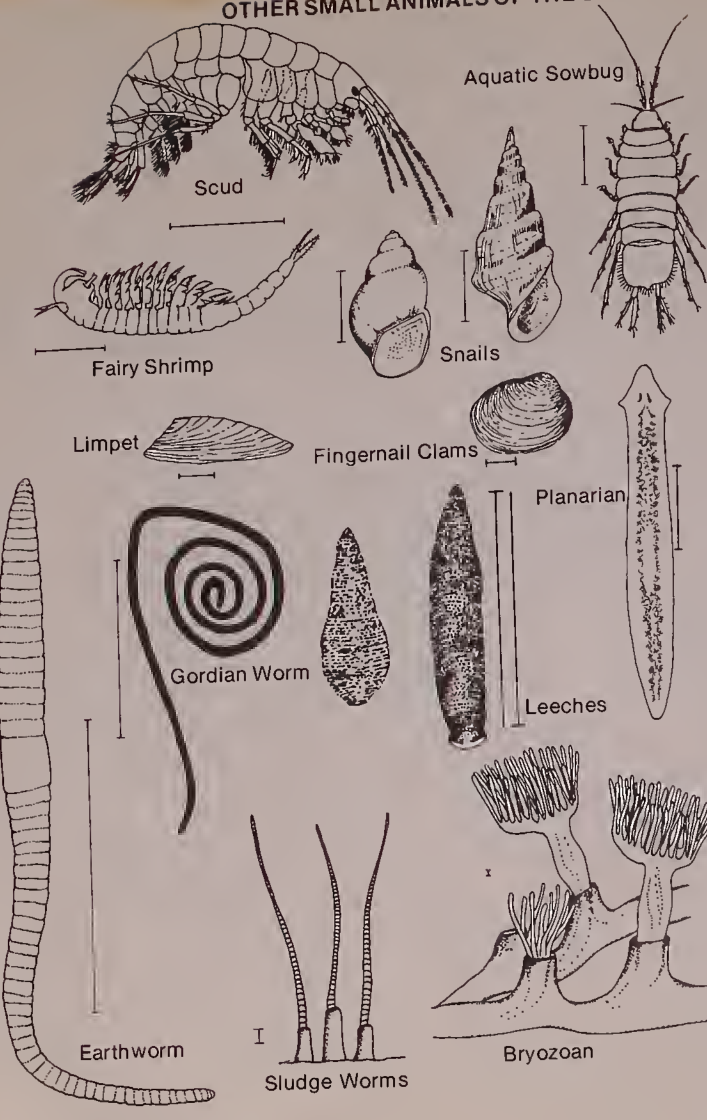
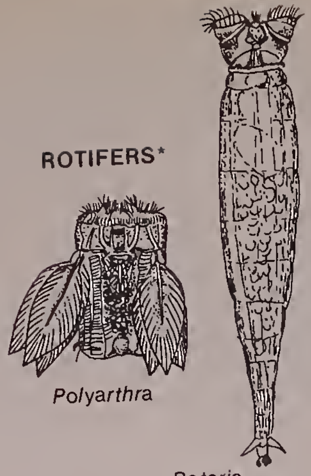




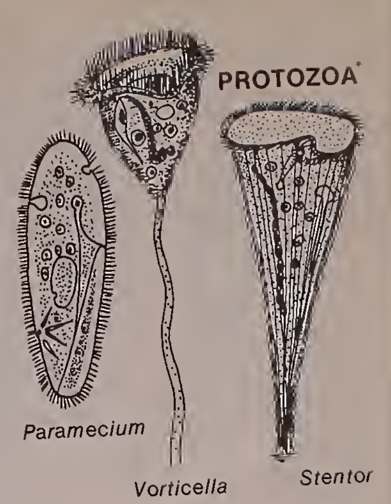
OTHER SMALL ANIMALS OF THE CREEK



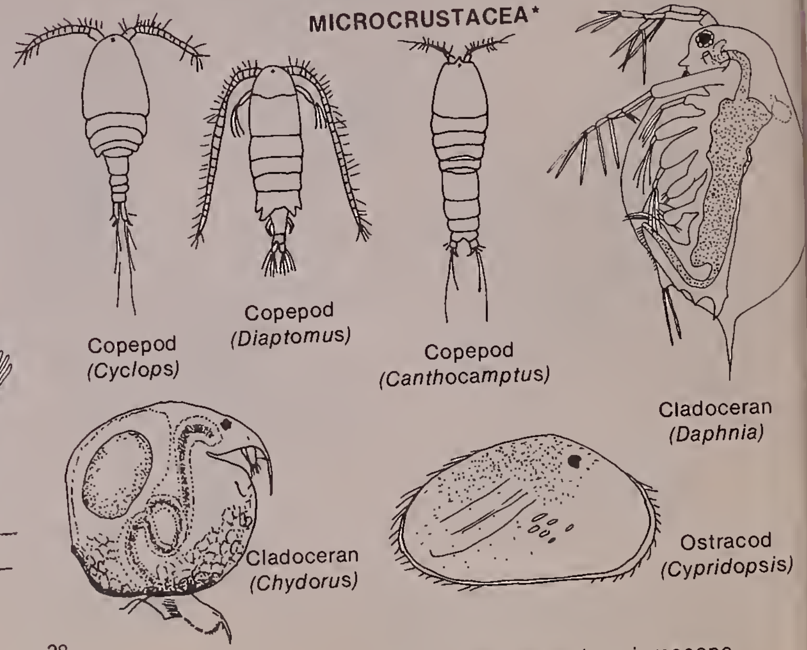
ROTIFERS*



PROTOZOA*



MICROCRUSTACEA*



* As viewed under the microscope

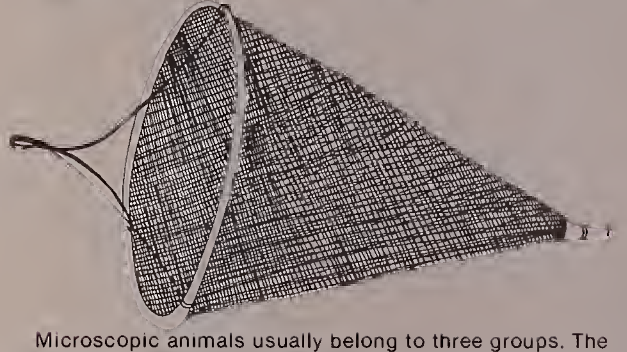
Microscopic Animals

Because the water is flowing, many of the microscopic animals in creeks are able to attach themselves to the rocks, pebbles and sand which line the creek bed. The faster the creek is flowing, the fewer will be found swimming free in the water.

The best way to study the microscopic animals of creeks is to scrape the surface of pebbles and rocks with a pen knife. The scrapings should be transferred to a water drop of a slide and examined under a microscope.

In spite of the above, there are free living microscopic animals in creeks. They survive better in the back eddies but some are always being picked up by the current and are swiftly carried away down stream.

By securing a plankton net in a stream for a period of 15 min or more, some microscopic animals will usually accumulate in the cup at the end of the net.



Microscopic animals usually belong to three groups. The smallest animals include the single celled animals called **protozoa**. In creeks this group is extremely varied. A few represented are illustrated so you and your students can identify them.

More common among the tiny animals are multicellular animals called **rotifers**. These may be even smaller than some of the single celled protozoa! Nevertheless, they are made up of many cells and contain a relatively complex digestive system. They feed by creating currents which carry bacteria and other food organisms to the crunching jaws of these animals.*

The third group of microscopic organisms are often the most common, especially in slow moving streams during spring. These are tiny microscopic shrimp-like organisms which are called **Microcrustacea**. They are made up of many cells and are related to the more familiar shrimp and crabs. They feed on microscopic animals such as protozoa and microscopic plants like bacteria, fungi and algae. In turn these tiny animals can form a very important food for the fish which swim in creeks.

Flowering Plants of the Creek

There are many kinds of flowering plants which can grow submerged in creeks. Certain kinds of plants grow only in areas where their bases are constantly submerged in water. An exploration of the creek for these species should be quite successful. Whenever a likely specimen is found, a search around the shore is appropriate to make sure that it isn't growing on dry land and thus just temporarily swamped at this particular spot. It may grow quite happily in both land and water. Try to find some kinds that grow only in water.

Several species are completely supported by water and their leaves float at the surface though they are rooted in the creek bottom. What happens to these plants when the water level changes? Some children may speculate that they will die; others may think it won't make much difference. To find the answer, suggest that they transplant one sample of each species to a place where the water is half as deep as where the plant was found, and one sample to a place where the water is twice as deep. It may be necessary to use small rocks to hold the roots down and to prevent them from being washed away in the current. Also they might try transplanting one specimen to the shore. During transplanting, be sure to measure the stem length and measure it again after a few days. Note the changes over the next few days. These investigations should answer the question of whether these plants can adapt to changes in the water level of the creek.

Do water plants seem to prefer the fast flowing or slow flowing creek sections? What kinds of bottoms do they like the best? If these questions are presented to them, the students will be able to conduct their own surveys to answer them. Have them compare a water plant leaf with a land plant leaf. Do they feel different? Ask them to look at the leaves closely. Do they look different? If you have

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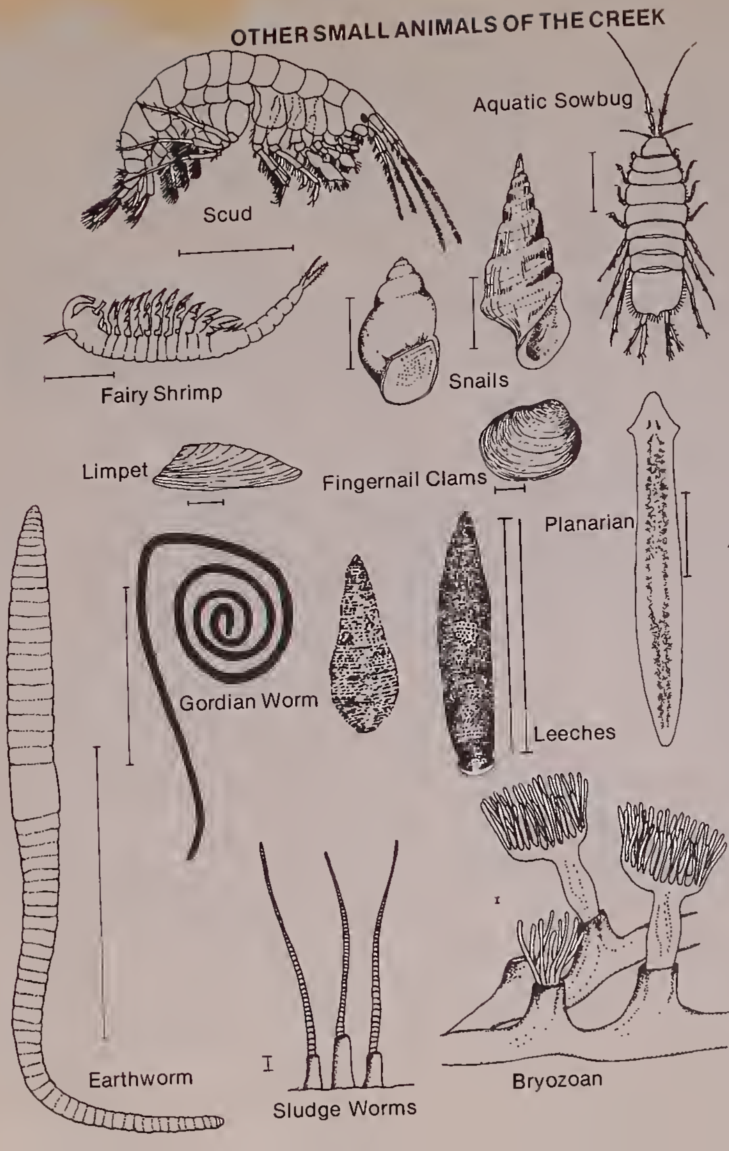
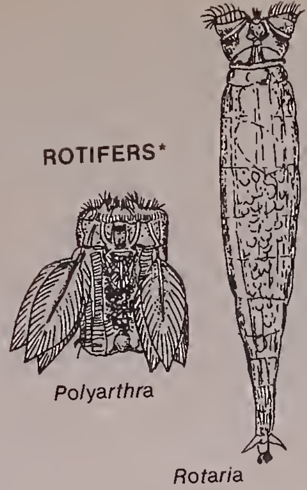
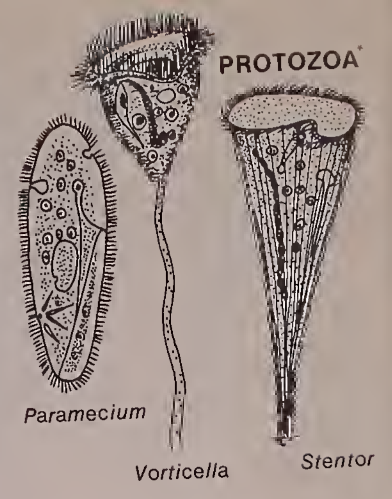
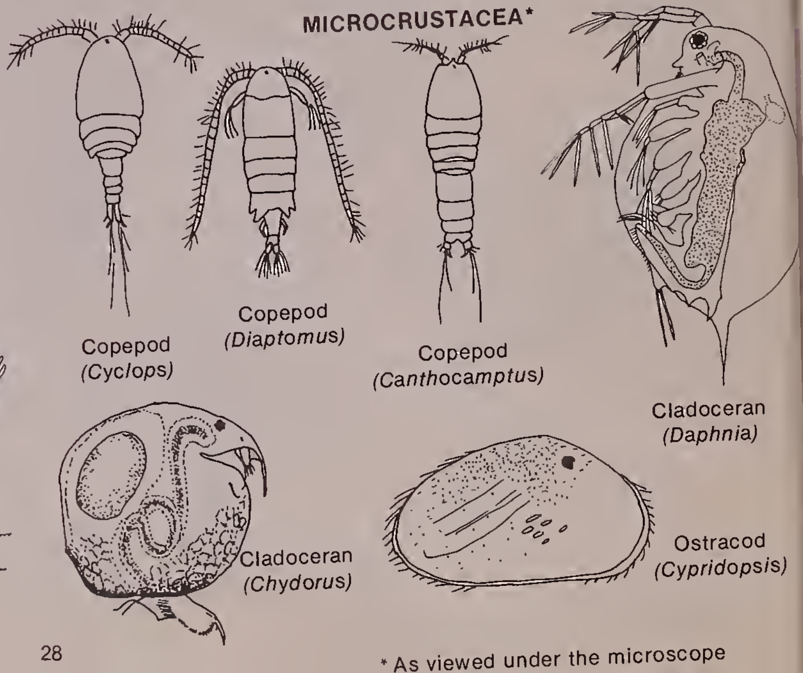
* See the film loop *Rotifers*, Elementary Science Study, McGraw Hill, New York, 1966.









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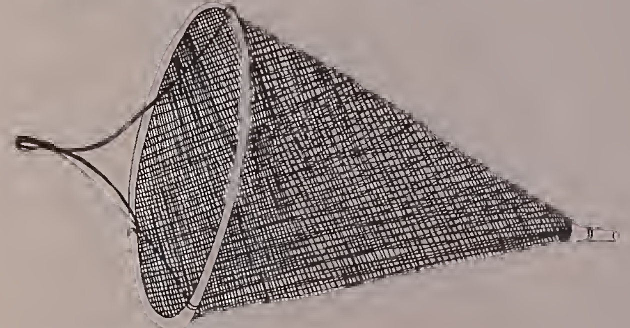
In spite of the above, there are free living microscopic animals in creeks. They survive better in the back eddies but some are always being picked up by the current and are swiftly carried away down stream.

By securing a plankton net in a stream for a period of 15 min or more, some microscopic animals will usually accumulate in the cup at the end of the net.



Microscopic animals usually belong to three groups. The smallest animals include the single celled animals called **protozoa**. In creeks this group is extremely varied. A few represented are illustrated so you and your students can identify them.

More common among the tiny animals are multicellular animals called **rotifers.** These may be even smaller than some of the single celled protozoa! Nevertheless, they are made up of many cells and contain a relatively complex digestive system. They feed by creating currents which carry bacteria and other food organisms to the crunching jaws of these animals.*

The third group of microscopic organisms are often the most common, especially in slow moving streams during spring. These are tiny microscopic shrimp-like organisms which are called **Microcrustacea.** They are made up of many cells and are related to the more familiar shrimp and crabs. They feed on microscopic animals such as protozoa and microscopic plants like bacteria, fungi and algae. In turn these tiny animals can form a very important food for the fish which swim in creeks.

Flowering Plants of the Creek

There are many kinds of flowering plants which can grow submerged in creeks. Certain kinds of plants grow only in areas where their bases are constantly submerged in water. An exploration of the creek for these species should be quite successful. Whenever a likely specimen is found, a search around the shore is appropriate to make sure that it isn't growing on dry land and thus just temporarily swamped at this particular spot. It may grow quite happily in both land and water. Try to find some kinds that grow only in water.

Several species are completely supported by water and their leaves float at the surface though they are rooted in the creek bottom. What happens to these plants when the water level changes? Some children may speculate that they will die; others may think it won't make much difference. To find the answer, suggest that they transplant one sample of each species to a place where the water is half as deep as where the plant was found, and one sample to a place where the water is twice as deep. It may be necessary to use small rocks to hold the roots down and to prevent them from being washed away in the current. Also they might try transplanting one specimen to the shore. During transplanting, be sure to measure the stem length and measure it again after a few days. Note the changes over the next few days. These investigations should answer the question of whether these plants can adapt to changes in the water level of the creek.

Do water plants seem to prefer the fast flowing or slow flowing creek sections? What kinds of bottoms do they like the best? If these questions are presented to them, the students will be able to conduct their own surveys to answer them. Have them compare a water plant leaf with a land plant leaf. Do they feel different? Ask them to look at the leaves closely. Do they look different? If you have microscopes, use them for looking at the skins and sections of the leaves.*

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* See the film loop *Rotifers*, Elementary Science Study, McGraw Hill, New York, 1966.

Water plants don't have a waxy covering to protect against drought like land plants. They also have fewer stomata or pores and have large air pockets between cells. Children should notice that the cells aren't as closely packed. Can the pupils suggest why the plants would need these air pockets? (The plants are kept afloat by the buoyancy provided by the air pockets.)

WATER PLANT DATA SHEET

1. What does it look like? ______________
2. Can it stand up by itself? ____________
3. Is it rooted or floating? ______________
4. How fast is the creek moving where it is found? ______________________
5. How many other plants of the same kind can you see? ____________________
6. What is the creek bottom like around the plant? (Sand, gravel, clay, silt or mud?) ______________________________
7. How deep is the water where it grows? (Measure several locations if there is more than one plant.) ______________
8. What is the range of water depth in which the plant can be found? _____________
9. What is the range of creek bottom types in which you found it? _______________
10. Does it like sun or shade? _____________
11. What do you think its name is? _________

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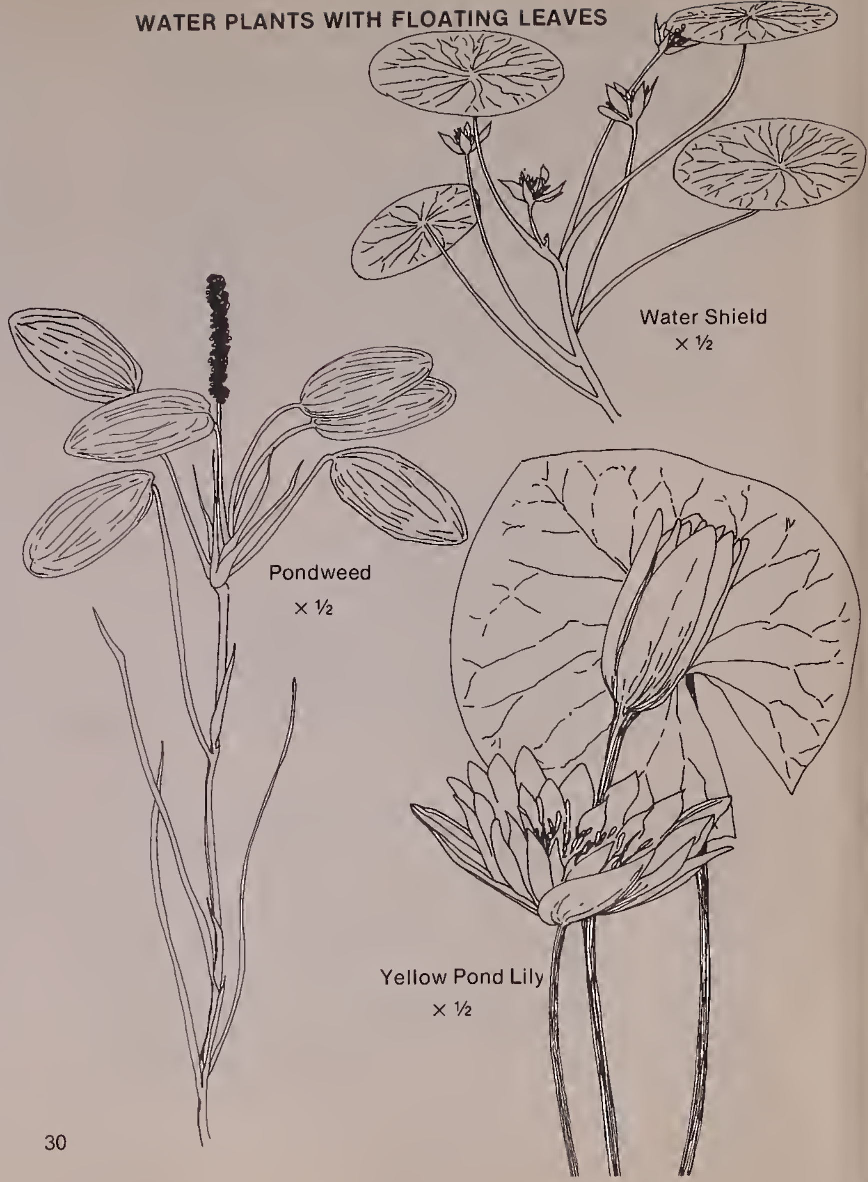
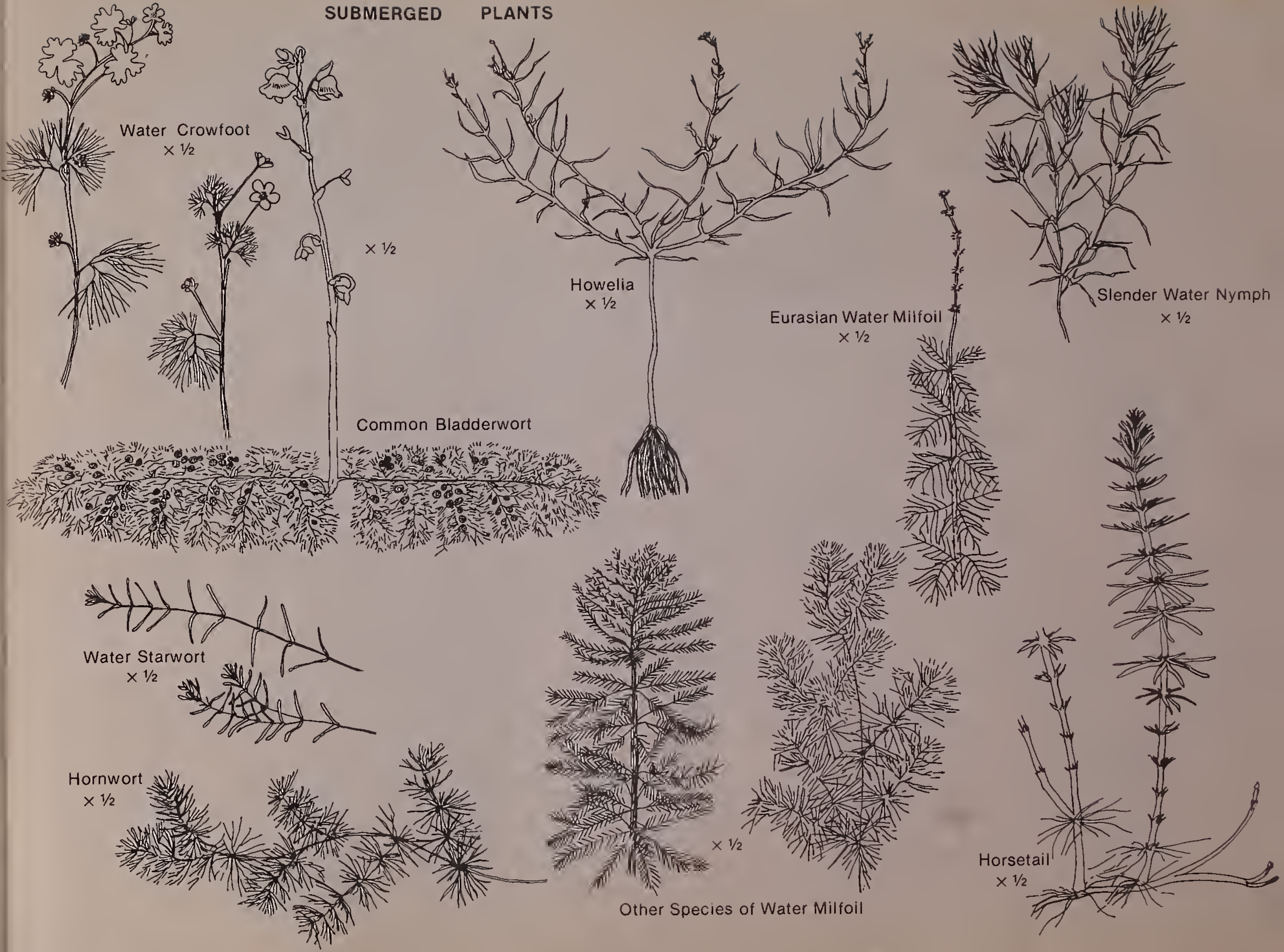
*For making sections of leaves, see the WEDGE Unit, *Seeing Through the Trees,* Western Education Development Group, The University of B.C., 1977.

WATER PLANTS WITH FLOATING LEAVES



SUBMERGED PLANTS



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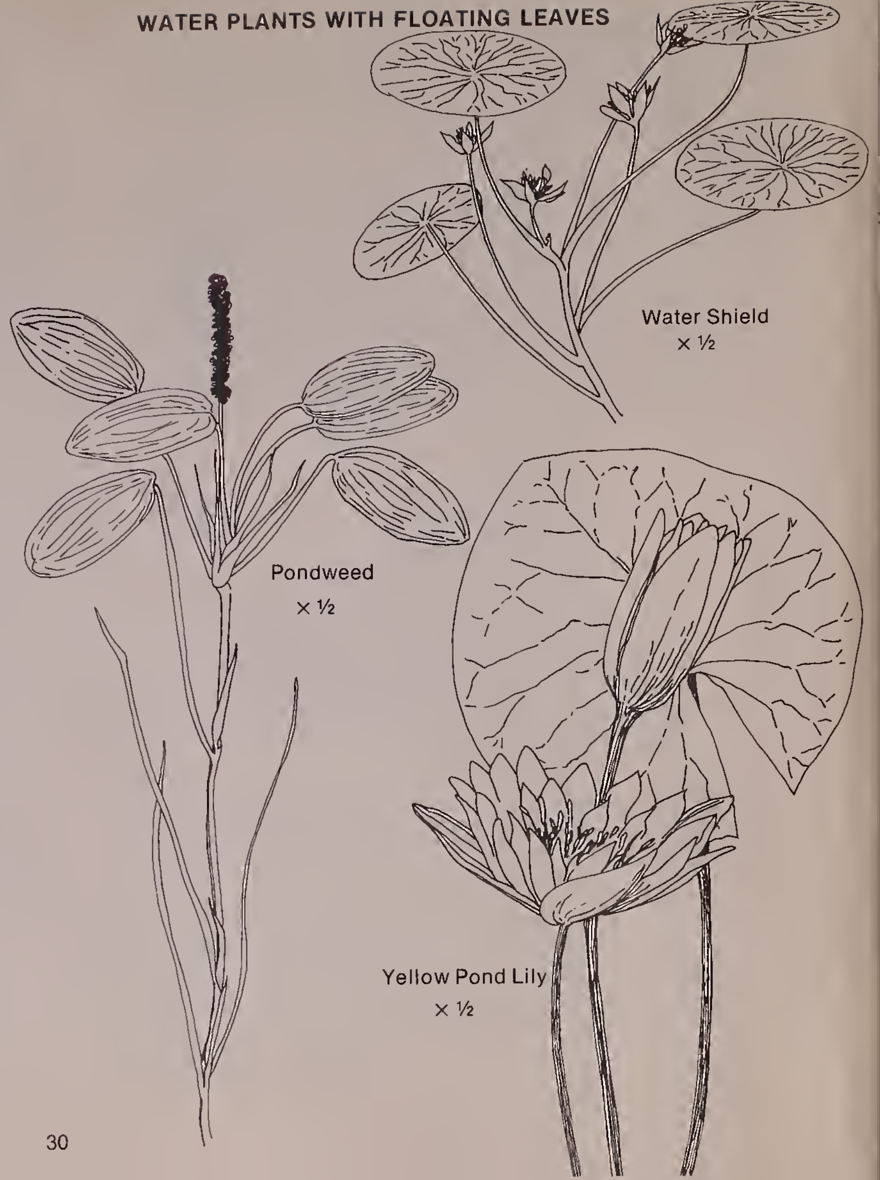

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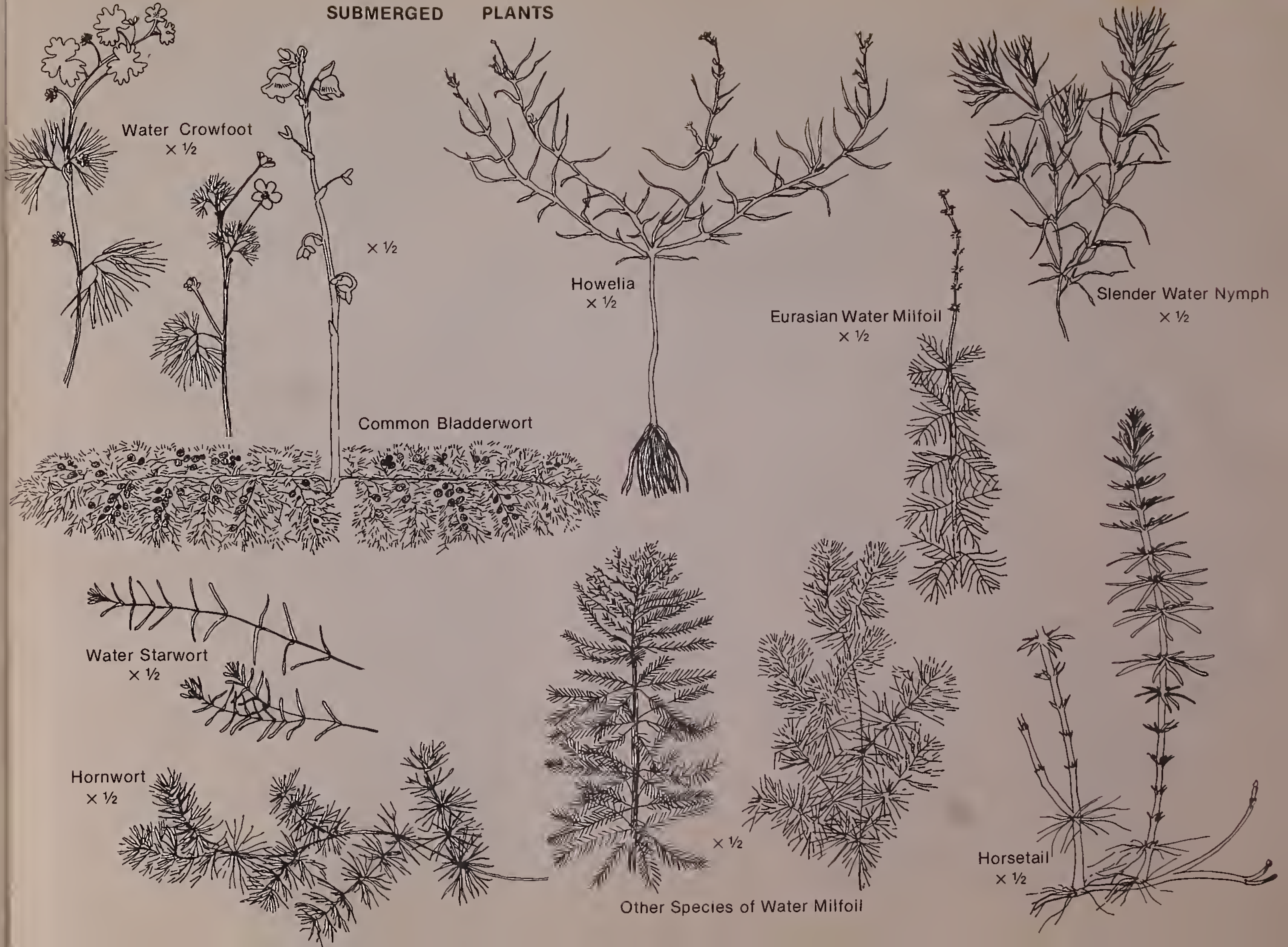

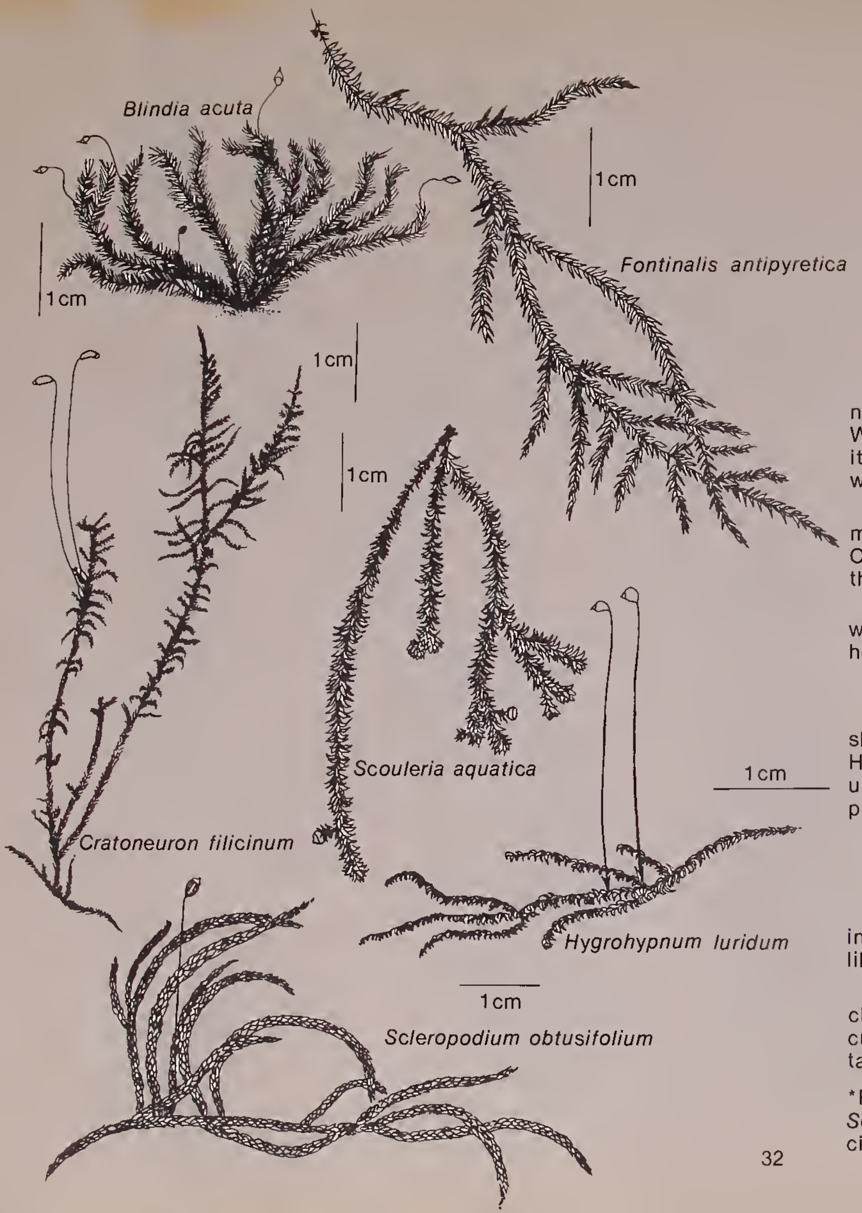

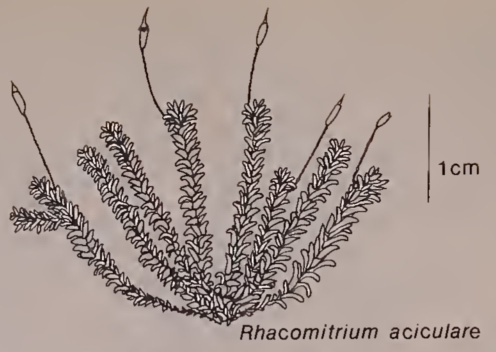

The Mosses of Creeks

When children walk along a creek they usually fail to notice the dark green fuzzy covering of stones in the creek. When their attention is directed to it they usually recognize it as moss. Indeed, there are a number of kinds of mosses which can live entirely submerged in creeks.

Often the rocky bed of a swiftly flowing creek is lined with mosses. Chief among these is often the fountain moss. Other mosses cover the upper surface of boulders or line the rocky bank of the creek.

Collect some of the mosses and try to identify them. They will probably be among the kinds which we have illustrated here.*

Microscopic Green Plants

Some plants are extremely small and look like scum or slime on rocks and pebbles. These plants are called algae. Have the children collect some of this material and look at it under a microscope. They may have trouble deciding if it is plant matter or not. You might ask:

— What colour are they?
— How do they attach themselves?
— Do they have roots? Stems? Leaves?

The observations made here might provide an excellent introduction to a discussion of what a living thing must be like to be called a plant.

The microscopic green plants (mostly algae) of creeks include many interesting species. The faster the current of the creek, the greater the tendency for these tiny plants to be attached to the bed of the creek.

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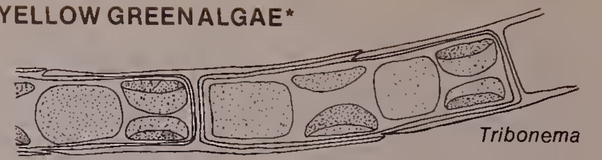
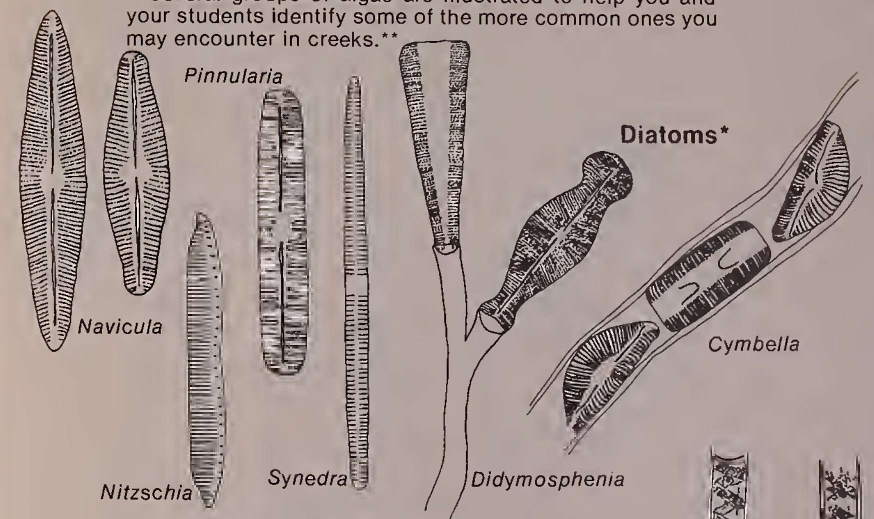
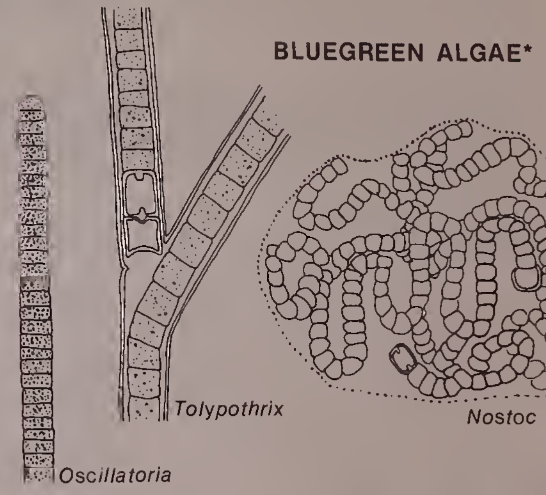
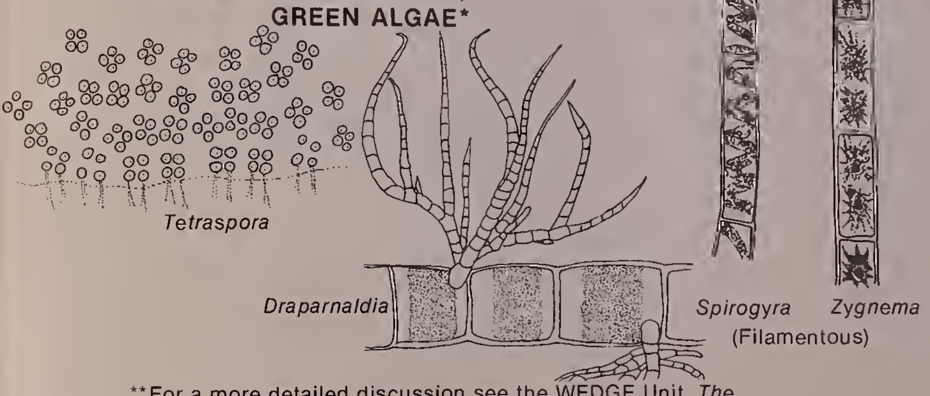
The students may wish to study the green scum which often accumulates at the banks and in back eddies of streams. Observation under the microscope will show that these microscopic plants can be made of **one cell**; they can be joined end to end together to form a **filament**; or they can be stuck together in a clump to form what is called a **colony.**

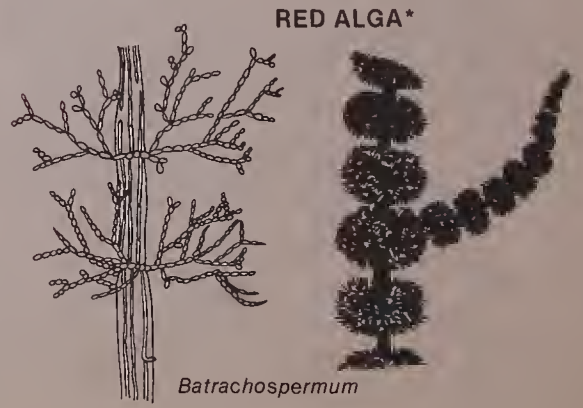
Several groups of algae are illustrated to help you and your students identify some of the more common ones you may encounter in creeks.**











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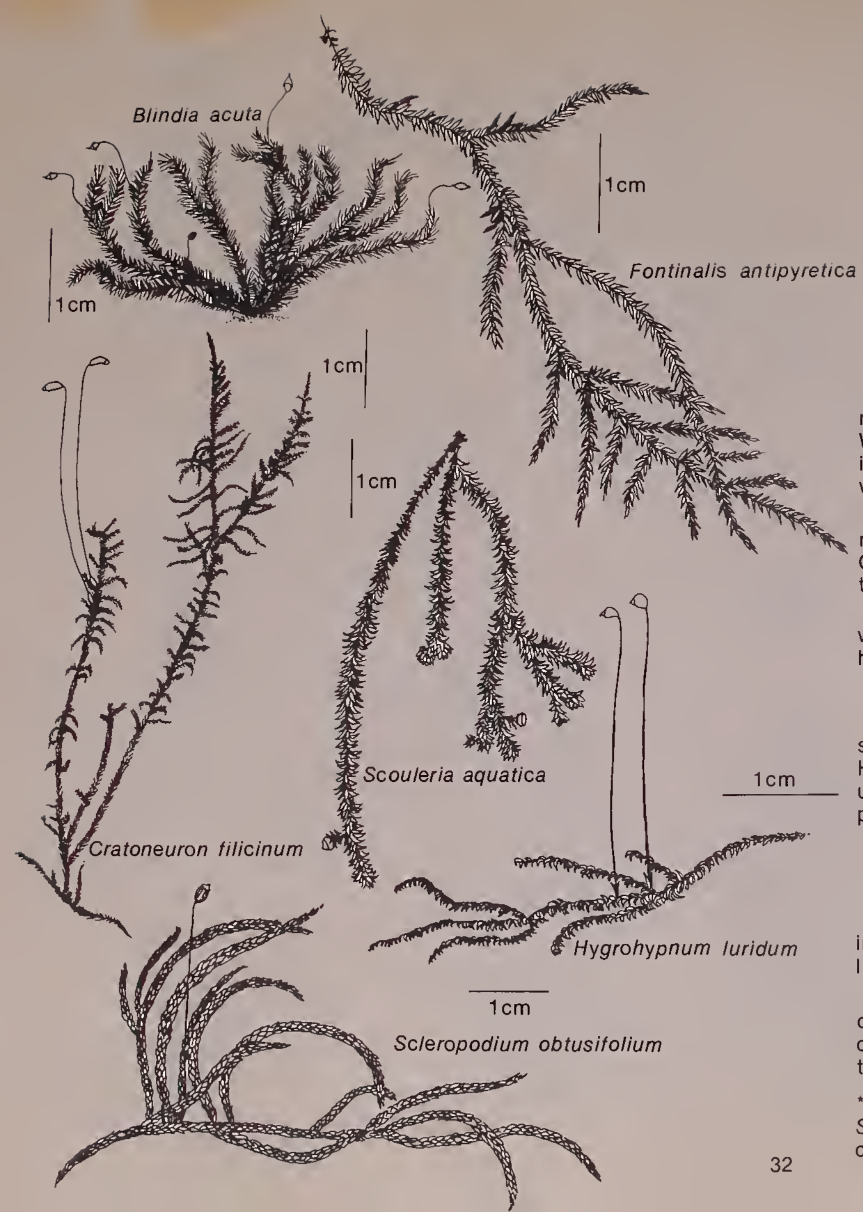

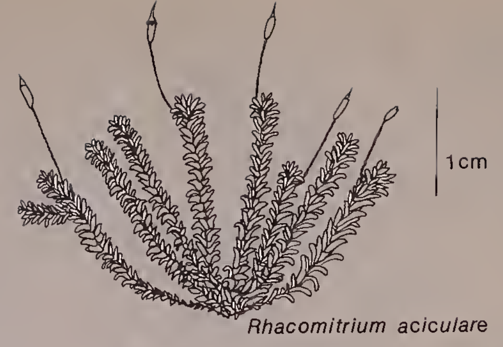

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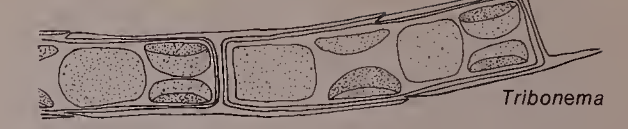
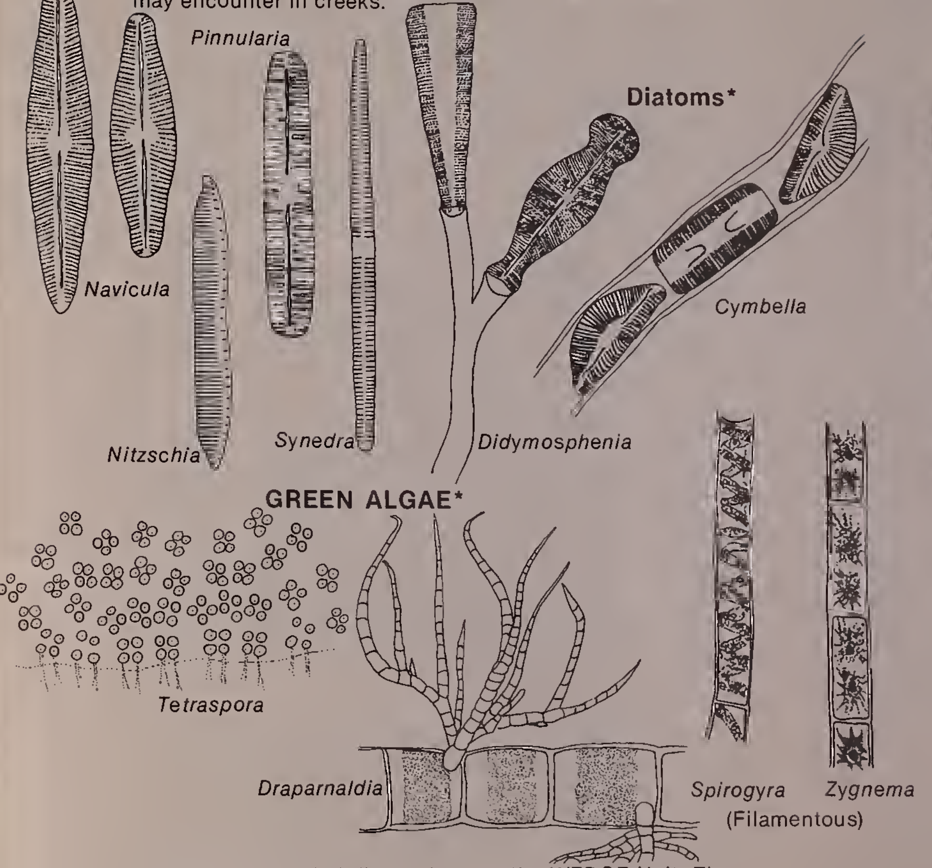
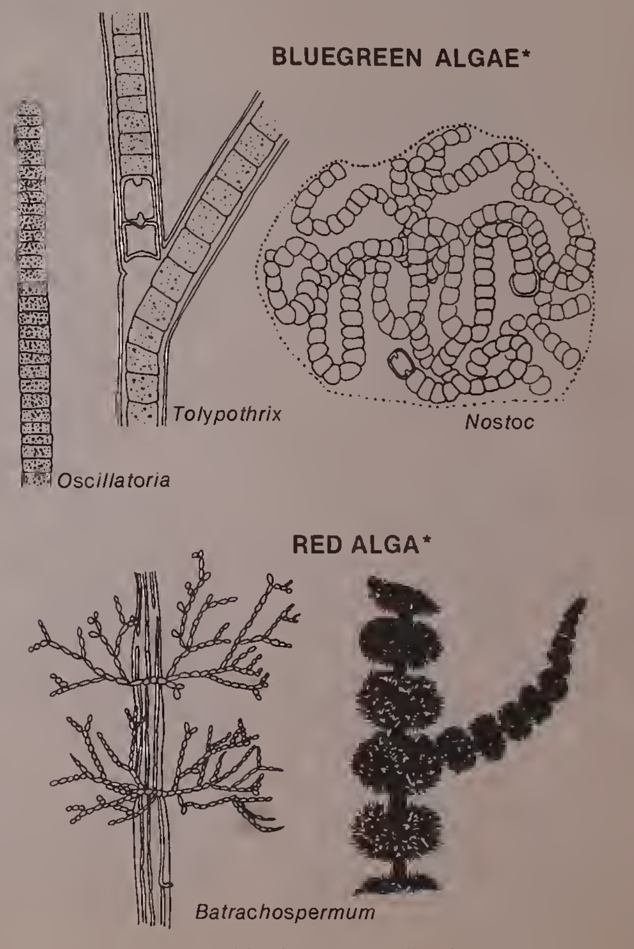
YELLOW GREEN ALGAE*







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Creek Foam

Foam accumulates in the back eddies of almost every creek. These are usually found in places where the creek is partially dammed by rocks and branches. Children often wonder what it is, and assume that it must be soap suds. Perhaps a comparison of this foam to soap suds would shed some light on the subject. These studies are not meant to imply that is is not soap suds, for it may well be, though this is quite rare.

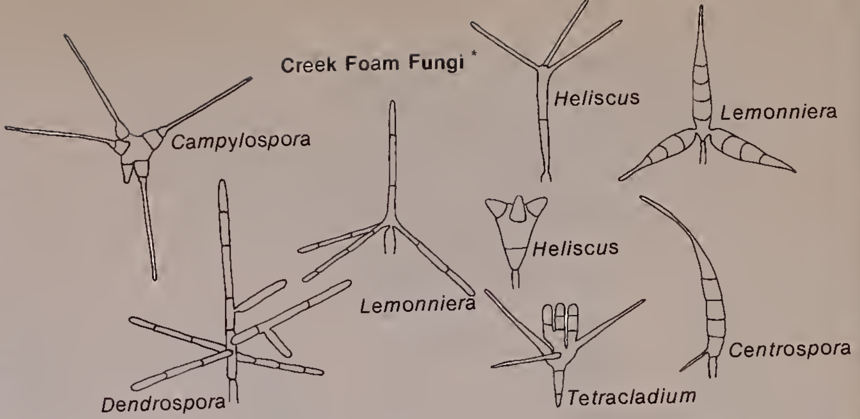
Have the children collect a sample of foam in a vial or a jar. When you get back to class the students can make up an equal amount of soap suds in another vial or jar. The two should be inspected and carefully compared using a magnifying glass. Here are some questions you can ask:

- Do they look exactly the same?
- Which appears denser, soap suds or creek foam?
- Which one has the largest bubbles?
- Is there any difference in colour?
- Which foam breaks down completely first?
- Which sample leaves more liquid when it has broken down?
- Compare the liquid left behind when the foam and soap suds break down. Which one seems thicker? Which one is cleaner?

After the bubbles have all broken, try shaking the samples to make foam again. Can both samples be turned into foam again?

Creek foam is usually denser than soap suds, since the bubbles are smaller. It takes longer to break down and doesn't make bubbles easily when it is shaken. The liquid left is denser and the colour is usually darker. From these observations, the children will probably decide that foam is not soap suds. However, there is a possibility that it might be caused by soap if the creek drains a populated area. If the creek drains a naturally wooded watershed, on the other hand, it isn't likely to be polluted with soap.

Have your students examine soap suds under the microscope. They will be disappointed to find nothing there! But no such disappointment occurs when creek foam is examined under the microscope. It is usually full of microscopic plants. The dirtier the sample, the more life will be in it, so choose a particularly dirty sample of foam to examine.


Creek Foam Fungi *

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Students will probably be able to see many colourless structures with a number of arms protruding out. These beautiful structures are the spores of fungi which decay leaves in streams. They stick to the under surface of the water and accumulate in foam when the water is whipped up in rapids etc. Your class may be able to identify some of these fungi from the illustrations.

Studying Rainwater at the Creek

Most field trips are cancelled in wet weather, but this particular activity can only be successful in the pouring rain. If appropriate clothing, including waterproof headwear, is worn, there shouldn't be a health hazard. Try to avoid umbrellas, as they are too unwieldy and there is danger of pupils poking each other (accidentally of course!).

It is possible for these activities to be carried out in your own schoolyard. However, it will help the children to understand the relationship between erosion and the role of the creek in carrying away eroded materials if an exposed area near the creek is chosen.

What is the effect of an individual raindrop on soil?* A way to find out is to spread a thick even layer of dirt on a board and pack it down. Put a few small stones on top and watch what happens when the raindrops land. If the children look closely, they will see the soil being splashed around.

*For a more detailed study of the effect of water on soil, see the publication, *Grounds for Erosion,* Western Education Development Group, The University of B.C., 1974.

After enough drops have landed, they will notice little peaks of soil forming with a pebble sitting on top of each peak. The stones protect the soil beneath them while the rest of the earth is greatly disturbed, splashed about, and washed away.

To examine this phenomenon further, place a little mound of soil in the centre of a white sheet of paper. Watch closely as the soil particles get bounced off the mound by raindrops. How far away does the rain bounce each particle? Perhaps it can be measured.

What happens to a raindrop when it hits a leaf? On impact, the drop is broken into smaller droplets, some of which never reach the soil. Of those that do reach the ground, their speed has been broken and as a result, their impact is reduced.

On another piece of paper with another small mound of soil, sprinkle a handful of grass over the dirt. How far does the soil bounce now? With this experience the children may be able to explain how plants protect the soil from raindrops.

In order to study the water holding capacity of plant cover, pick out a grassy place beside the creek bank. Using two cookie sheets or flat boards, have the children place on one a clump of sod and on the other evenly spread soil. Hold them at a slant and let the rain pour down on them.

If it is not raining very hard, you can speed things up by pouring cupfuls of water from the creek on the boards. You may also leave them propped up and come back later when the changes will be more obvious. Discuss what happens to the soil on each tray.

This would be a good time to speculate on what would happen if all the land around the creek were cleared for a housing project. Discuss with the children possible changes in the creek in terms of water volume and the amount of sediment. Do they think the water would still be as clear?

- Can they predict what would happen to the soil from the surrounding land?
- How would this area be different during a long hot summer?
- How would it be different during a heavy rainfall?

The answers the children give to these questions should demonstrate their understanding of the water holding capacity of soil and plant cover.

Erosion in Creeks

Because erosion is such a slow process, it is difficult for the child to view it as relevant to his own world. Perhaps the creek began carving itself a bed years ago. We as adults can't help but be a little amazed at the time recorded in the depth of its banks. But children don't have the same concept of time as we do since their experience has been much shorter. For this reason, we must introduce erosion as an ongoing process, happening now, not in terms of what it has already done.

To study the effects of stream flow on erosion, the students can design very interesting experiments. Pick a shallow area (less than 10 cm deep) where the water is flowing slowly and another where it is flowing more quickly. Using a small flower pot for a mold, make a series of small "islands" of soil, sand and gravel. Make one of the "islands" with sod. Pack each tightly into the flower pot and then carefully turn the pot over in the water holding the material in with your hand until it is upside down on the creek bottom. Then slowly remove your hand pushing the pot tightly to the creek bottom. Remove the pot so the "island" is exposed in the water. You may have to tap the pot to loosen it.

Once the island is exposed notice how it erodes away. Do all sides erode evenly? Where does the greatest erosion occur? Using a watch, determine how long it takes for the island to disappear.

Use the same process for all the islands your students made of different materials. Try "islands" of each type of material in fast flowing water and in slow moving water. Make a chart to show how fast they eroded.

Try drawing the shape of a half eroded "island". Do the different materials erode to produce different shapes?

This experiment introduces another question. What happens to the material which is carried away? Is there eroded material in creek water all the time? One way to find out is to collect creek water in jars and let it stand so the material can deposit on the bottom. Is there more sediment in fast moving water or slow moving water? What happens after a rainstorm?

Ask the children to speculate where this eroding material goes to. The fan at the mouth of a ravine or mountain valley is formed by material eroded by a stream. It is deposited at the mouth of the stream where it reaches the valley bottom,

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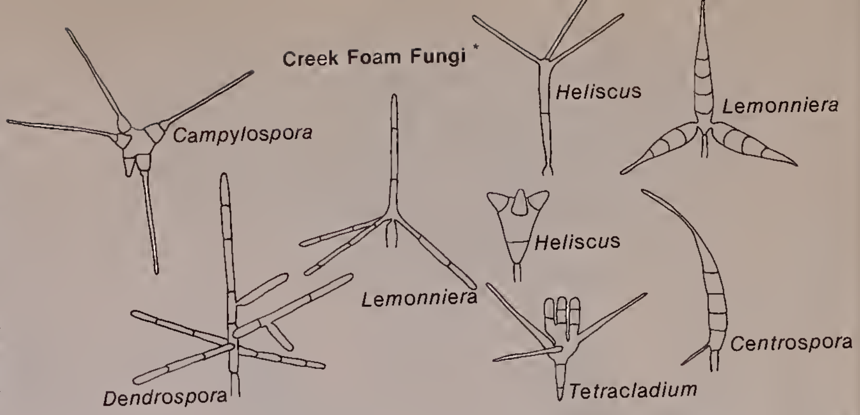
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Ask the children to speculate where this eroding material goes to. The fan at the mouth of a ravine or mountain valley is formed by material eroded by a stream. It is deposited at the mouth of the stream where it reaches the valley bottom,

HOW FAST THE "ISLANDS" DISAPPEARED

	Slow Water	Fast Water
Soil	17.5 min	1.5 min
Sand	28 min	2.5 min
Gravel	never disappeared after 3 d (days), got more spread out	15 min
Sod	never disappeared after 3 d (days), stayed same shape, some soil washed away	soil washed away, then roots were carried away after 2 d (days)

or where it flows into a river, a lake or the ocean. On these fans one can see several old stream channels on both sides of the present one. Why would the stream change its location as it flows over the fan? How are deltas formed? What is a delta? Where does the material come from that is deposited at the mouth of the Fraser River?

Meandering

Why does the creek bed run where it does? Many creeks seem to wander aimlessly back and forth giving only a vague hint of their final direction. What causes them to do this?

The phenomena of meandering can be studied with the aid of a model. Have the children watch the path which is formed when a steady thin stream of water is poured onto a cookie sheet or flat board which has one end propped up at a 20-30° angle. Compare this to the stream formed when the board is lying almost flat on a level surface.

The path formed on the raised board will be a straight line. On the board which is almost flat it will meander back and forth. Similarly, creeks will tend to wander this way and that when they travel over a flat area. Clearly it is the slope of the land which defines the route the creek will take.

Does your creek meander? Have the children explore the creek looking for places where it weaves back and forth. When they find such a place, have them look carefully at the land around and discuss other possible paths the creek might have followed. Have the children consider the height of the banks. Is it too difficult to change the creek's path? Has the water flow eaten away too deep a channel for it to be diverted now.

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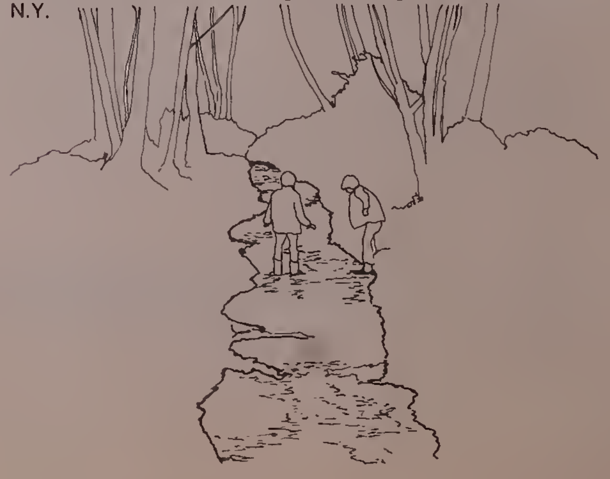

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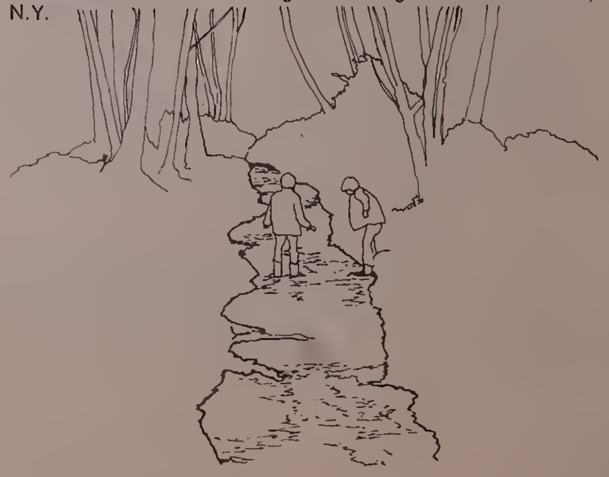

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